

SCIENCE.

FRIDAY, SEPTEMBER 26, 1884.

COMMENT AND CRITICISM.

THE historical method is now applied to the solution of so many questions of every-day life, formerly studied in the light of philosophy, that the formation of an American historical association really marks the opening of a new era in the history of scientific research. Henceforth historical students, like other scientific men, will have an opportunity to make themselves known, without awaiting the tardy recognition of a publisher. It is for the future to show whether the high standard already set up can be maintained; but, assuredly, there is no reason why the meetings of the association should not be the chosen place for the best students to make known the results of their labors.

IN 1872 Professor Asa Gray relinquished to younger hands all instruction in botany in Harvard university, in order that he might give his time to the completion of the 'Flora of North America.' Notwithstanding the many serious encroachments which have been made upon his time by the demands of the herbarium, by the voluminous contributions to the proceedings of the American academy, by his editorial work in connection with the *American journal of science*, by the revision of his text-book, and by his very extensive correspondence, he has carried a second volume of his great treatise through the press. It seems proper for us, in connection with the review of this volume in another part of this number, to remind our readers of the forcible and yet pathetic appeal which Professor Gray has more than once made in behalf of an exemption for himself and Mr. Sereno Watson from the time-consuming task of answering notes of inquiry respecting the more common plants of our flora. Thanks to botanical activity at

various places throughout the country, beginners can have their questions well answered by local societies, while more advanced students can now easily confer together in regard to the more difficult points. By such sifting as this would bring about, the number of questions which should properly be referred to the herbarium would be surprisingly diminished. It must seem plain to every one of our readers, upon reflection, that it cannot be discourteous, in the officers of our larger collections which are now being utilized in the preparation of works of reference, to quietly ignore those letters which ought never to reach them.

WE owe our readers a word of explanation, which we make this week, *apropos* of the long letter of reclamation on another page. It is the aim of *Science* to express just and impartial criticisms whenever they are called for, and it is our intention to continue the pursuit of this aim. We regret extremely if any one believes that we are animated by any unjust prejudices against American work; but it is evidently our duty to be, if any thing, more outspoken in regard to American than to foreign scientific labor. In writing of our own country, we do not wish to let false pride substitute laudation for justice, neither do we wish to praise any thing merely because it is from abroad. It is a heavy accusation which our correspondent makes against us, and we hope our readers will acquit us. Dr. Salmon's assertion that American work on Microbia includes some of the best researches on the subject does not coincide with the opinion of competent and uninterested judges. We must therefore still adhere to the judgment we have expressed as to the relative value of American contributions to the knowledge of micro-organisms. If Dr. Salmon's own work is recognized hereafter to have the value which he assigns to it, we shall be very happy to acknowledge the

change of opinion on the part of those in whose decisions on the matter we have full confidence.

It is quite impossible for congress, when it grants an immunity to colleges in the importation of printed matter duty-free, to set forth in detail the administrative processes which are necessary to secure its purpose. Congress acts on the assumption that the executive departments of government have wisdom enough in so ordering details, that the purpose of congress shall be adhered to, and that education shall have the advantages the people, through them, have decreed. Everybody but an executive routinist, whose perceptions are dwarfed by his habit, sees a higher claim in the spirit than in the letter of a law. It were a libel on barbarism to stigmatize as barbaric the recent decision of the treasury, which requires twelve oaths a year and attendant time and money for a monthly periodical to secure a free entry. Let us commend to the astute revenue-officials the story of Poor Richard and the barrel of salt beef, when a single grace over the whole could save for twelve-months' dinners a considerable fraction of the time allotted to the poor dwellers of the globe. Further let them remember graces at dinner do not cost notary's and justice's fees.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The Ohio earthquake.

A slight earthquake was felt here at 2 h. 43 m. this afternoon. Hanging lamps were made to vibrate, and at one of the public-school buildings a panic occurred among the children. The shock was not noticed by those who were busily employed at the time. No attempt was made to measure its direction or force.

E. T. NELSON.

Delaware, Ohio, Sept. 19.

The steep slopes of the western loess.

In Mr. Macfarlane's paper on the formation of cañons and precipices (*Science* for Aug. 1), there is a discussion of the cause of the steepness and permanence of the slopes in the loess region of the west. The fact is certainly a striking one. But Mr. Macfarlane's explanation, likening it to 'a well-built piece of miniature natural earth masonry well bound together,' scarcely does justice to the subject. For, in the first

place, the steep slopes recur in the typical loess, even after it has been moved and worked over; especially after it has lain for a few years, so that a slight 'binding-together' of the particles by calcic carbonate is renewed. In the second place, the form of the loess particles is, as a rule, not flattened, but roundish; as can readily be seen, when the sediments from a mechanical analysis of the material are examined. But this general roundness of the particles is accompanied by an extreme roughness of surface, precisely such as is seen on the large scale in the 'loess puppets' themselves. The entire mass, in fact, consists of small calcareous secretions, with rough concretionary surface, intermingled with a comparatively small proportion of fine dust and clay (see *Amer. Journ. sc.*, n. s., vii. 10); and, when treated with dilute acid, the whole frequently becomes altogether impalpable. These rough concretionary sand-grains naturally can move only with great friction in the mass; and the latter being, moreover, very porous, absorbing instantly even a copious shower, there is little opportunity for washing away. Aside from these purely physical causes, the rapid formation of a tissue of cryptogamic fibrils and gummy matter (mostly moss prothallia) on the fertile material, soon binds the surface, and imparts additional stability.

E. W. HILGARD.

Berkeley, Cal., Aug. 20.

An open polar sea.

In an article in the *New-York Herald* of Sept. 10, Joseph W. Cremin, A.M., comments upon some remarks made by me before the British association at Montreal, in regard to the theory of an open polar sea. Mr. Cremin agrees with Lieut. Greely in the belief that there is such a sea, but fails to put forward any facts in support of his theory. And in view of the fact that so far we have found nothing but ice along the southern border of this unknown region, it is fair to presume that the ice-cap extends over the pole, unless facts can be brought forward to prove to the contrary.

Now, the facts that have convinced me that there is no permanent open water are these: 1°. Migratory birds do not pass into this region beyond the highest known land; and there is a decrease of animal life as you go north, both in the sea and on the land. Also the annual mean temperature falls as you approach the pole. 2°. The ancient ice which is being constantly displaced by the new ice that forms in the cracks opened by tides and gales is constantly coming down from the higher latitudes. If there were an open sea to the north, would this be the case? It naturally yields toward the side of the least resistance. 3°. The water in the Arctic Ocean stands at a temperature of +29° F. from October until June, with a range of less than .3 of 1°. Off the northern coast of North America, the currents are variable; and if there were an open sea, which must necessarily be a warm sea, around the pole, we should have a variable temperature in the sea-water. 4°. There is less than 1,300 miles of this unexplored region on a line drawn from Lockwood's highest, over the pole, to North-east cape, Siberia. Now, if there were a sea of warm water in this comparatively small space, we should have in the region surrounding it a meteorological condition which does not exist. We should have a vast amount of precipitation during the winter, with cloudy weather; instead of the clear dry weather, with frequent calms, that we do experience. And the amount of precipitation decreases as you go north.

The difference in temperature between the flood

and ebb tide, noticed by Lieut. Greely, I think is explained by the fact, that, to the south of Robeson Channel, the sound is kept open more or less by a strong current, and the water so exposed loses more of its latent heat in the winter than that to the north where it is protected by the ice-cap; and as the difference was only about .2 of 1°, it may be there is a difference of density. As to Mr. Cremin's theory that the flattening of the earth at the poles brings the outer crust nearer to the internal fires of the earth, I can only say that I know it to be a fact that the surface indications within the arctic circle do not bear him out in his theory. As it is a well-known fact that the earth north of the arctic circle is perpetually frozen to a great depth, and as the earth probably cooled from the surface, it is fair to presume that it at least cooled as fast at the poles as at the equator; and I think that a residence of a year or two will convince any reasonable man that the crust is tolerably thick up there, if extreme cold has any thing to do with it.

P. H. RAY.

Washington, Sept. 13.

Discrediting American science.

On p. 48 of the current volume of *Science* you take occasion to say, —

"Work of value upon the subject of micro-organisms is not done in this country, nor will it be until some such encouragement is offered to investigators as is the case in France and Germany. This kind of research requires the rare combination of many forms of training, added to a critical, analytical, and judicial mind. These we can have; but until the facilities for work are offered, until the necessity for personal sacrifice and self-denial is done away with, we can hope for no better work in the future than has been done in the past: in other words, what is first needed in order to place our own investigations upon an equality with those of the two countries mentioned above, is a thoroughly equipped, fully endowed laboratory, with a strong corps of well-trained and salaried officials."

Now, while you doubtless had in mind, when penning this paragraph, the great desirability of more systematic investigation in this country of those plagues of mankind which annually cut short so many valuable lives, I cannot allow this sweeping and unjust assertion to pass unnoticed, and to stand as a disparagement to American science and a reproach to American investigators. Whether you realize it or not, it is nevertheless a fact, that the patient student of micro-organisms in this country has been laboring under the enormous disadvantage that his work, however valuable it may be, is discredited at home, and unnoticed abroad, while the most absurd generalizations of the European worker are received with approval there, and enthusiasm here.

Sternberg has worked for years on intermittent fever, tuberculosis, septicaemia, yellow-fever, germicides and allied subjects; and, beyond his own writings and the reviews of his books, what is there in American literature to show that such a man has existed? About the time that Pasteur announced the discovery of his now celebrated 'new disease' produced by inoculating rabbits with the saliva of a child dead of hydrophobia, Sternberg demonstrated the virulence of normal human saliva when rabbits were inoculated with it.¹ He also demonstrated beyond question that this was due to a micrococcus which might be cultivated to the eighth culture without losing its virulence, and even showed that an immunity might be

granted by protective inoculation.¹ Both had been working at the same time with the same organism, and had reached substantially the same result. Pasteur's work was published as something remarkable the world over; while Sternberg's — well, we must admit it received some credit abroad, even if it fell flat at home. Again: Sternberg's tests of germicides are, perhaps, the most extensive and satisfactory investigations in this line that have ever been made. He was certainly one of the first who attempted to obtain exact results by allowing a disinfectant of a given strength to act on a particular disease-germ for a given length of time, and then tested his results by cultivation and inoculation experiments.² And surely his experiments and results in photographing micro-organisms cannot be set down as entirely valueless.³

A short time ago the rather absurd speculations of Tyndall, in regard to the nature of the immunity from contagious diseases which is conferred by a previous attack, attracted wide-spread attention both in Europe and America. Tyndall's views were based upon the theories of Pasteur; and these, in turn, rested upon a very narrow basis of experimentation with fowl-cholera, which, at the time they were put forth, were far-fetched, and now are antiquated. Pasteur is a chemist, and Tyndall a physicist; and neither has any adequate conception of the fact that there are processes going on in the animal body which both chemistry and physics are incompetent to explain. Pasteur's chemical explanation of the mystery of immunity — that it was the exhaustion from the body of something necessary for the nutrition of the virulent germ; something that, once exhausted, was not again replaced — had a great fascination for the great English physicist, and he received it with childlike trust. What objection could there be, indeed, from his stand-point, to the view that a living body may be compared in every respect with the test-tube and the flask with which he is in the habit of experimenting in his laboratory? And when a Frenchman and an Englishman unite in pressing so plausible a theory, we surely could hardly expect from past experience that the American scientific editor would pay much attention to the vulgar home worker, no matter how striking his experiments, or how conclusive his demonstrations. I trust, however, you will pardon me for calling your attention to the fact that more than two years ago I demonstrated that immunity was only relative, and never absolute; that the most susceptible individual possessed a certain degree of immunity which can be accurately measured; and that all degrees of immunity may be overcome by a sufficient increase in the dose of virus. The immunity of the animal body, then, in no sense resembles the exhausted cultivation-liquid in the flasks of Pasteur and Tyndall, which no increase in the amount of virulent material added can ever induce to support the development of new generations of the microbe; and the honor of demonstrating this radical difference is due to American investigations.

I went farther than this, however, and showed that this theory of our European friends was absolutely untenable; because broth made with distilled water from the flesh of an animal that had been granted a very complete immunity was just as favorable a medium for the growth of the virus as that made from

¹ Bacteria. By Dr. ANTOINE MAGNIN and GEORGE M. STERNBERG, M.D., F.R.M.S. New York, *William Wood & Co.*, 1884. pp. 355-376.

² *Ibid.*, pp. 209-235. National board of health bulletin, July 25, 1881.

³ Photo-micrographs, etc. By GEORGE M. STERNBERG, M.D. New York, *William Wood & Co.*, 1884.

¹ Bulletin of National board of health, April 30, 1881.

susceptible animals; and that such virus lost nothing in virulence by being grown in such a medium.¹ I will not trouble you with the theory of immunity which I developed from these experiments. Like other American work, it may have no value; but it may interest you to know that an able German writer in the last number of Virchow's *Archiv* has propounded a theory, which, in its most important points, is identical with my own.

In 1880 Mr. Chauveau published some observations and experiments which indicated that even a very virulent virus of a fatal disease might be made to produce a mild attack, if the dose administered was sufficiently small. About the same time I demonstrated by more numerous and direct experiments that this was true; but I went beyond this, and have the incontestible priority of demonstrating, —

1. That a certain number of the most virulent and fatal germs may be introduced into the most susceptible body without producing the least appreciable effect;²

2. That by increasing this number slightly, but still using a relatively small dose, germs which ordinarily multiplied throughout the whole body, and produced a constitutional disease, may be compelled to multiply locally, and cause only an insignificant local lesion without constitutional symptoms;³

3. That this local multiplication confers an immunity upon the whole body;⁴

4. That the immunity produced by a single inoculation with this diluted virus equals that produced by two inoculations with Pasteur's attenuated virus.⁵

Again: when Pasteur announced his discovery of the method of attenuating the virus of fowl-cholera, he coupled it with the theory that this attenuation was due to the action of atmospheric oxygen; and, although the evidence in favor of this theory was neither direct nor abundant, what there was of it came direct from Paris, and this was sufficient to secure it universal attention and unqualified indorsement at the hands of scientific editors. A few experiments led me to conclude, however, that this theory was incorrect, that the attenuation could be secured in the absence of oxygen as well as in its presence, and that it was really due to loss of vitality, the result of keeping the germs for a considerable time under unfavorable conditions of life.⁶

It is true that these conclusions did not receive the least notice, favorable or unfavorable, either at home or abroad; but, as they have since been established beyond question by the elaborate researches of Chauveau and others, I am inclined to think that the fault was neither with me nor my experiments, but that it is confined to the fact of the work being done by an American, and on American soil.

I need no more than call your attention here to the fact that I demonstrated which one of the several germs that had been described as peculiar to swine-plague was the actual cause of the disease, and that this was more than a year before the same experiments were duplicated by Pasteur and his assistants, who, nevertheless, succeeded in bearing off the honors that belonged to the American discoverer. This subject was placed before your readers in sufficient detail in a recent number of *Science*.⁷

In regard to the peculiarities of the germ of fowl-

cholera, and the exact effect of disinfectants and various conditions of existence upon it, you will find in my reports the record of nearly one hundred and fifty experiments which it has seemed to me might have a little, though possibly a very slight, value from the light which they throw upon the germ-theory in general, and especially upon that group of diseases caused by organisms which do not form spores.¹

The admirers of Koch are ever on the alert for an opportunity to enlarge upon the perfection of his apparatus and the security of his processes. They forget, however, that the most satisfactory work which he ever did, that which raised him from an obscure physician to be an acknowledged scientific authority, was accomplished with an apparatus so primitive and imperfect, that, were any one to use it to-day, it would only create ridicule and contempt. I refer to his cultivations of the bacillus anthracis in unsterilized liquid on ordinary microscopic slides, placed over wet sand in a soup-plate to prevent evaporation, covered with a plate of glass, and warmed over an oil-lamp. His disciples can, perhaps, afford to criticise imperfect apparatus now; but it may not be out of place to remind them, that, if their master's first work had been rejected on this account, he would probably still be an unknown physician in an obscure German hamlet.

After all, what is there in Koch's method of cultivation on the surface of solid media that makes it preferable, or even equal, for general purposes, to cultivation in liquids? Is any scientific man at this day so ignorant as to believe that the intermittent heating of blood-serum for half a dozen times to 137° F. (58° C.) is sufficient to safely sterilize it?² Is it not an incontestible fact that cultivations on solid substances cannot be made, examined, and reproduced, without exposing a large surface to contact with unsterilized air and the countless germs which it contains?

It is not my desire, however, to detract in any way from the well-earned reputation of Dr. Koch and Mr. Pasteur (there is no danger that they will ever receive too much honor); but, when American science is sneered at and rejected because of alleged imperfections, one can scarcely avoid calling attention to the fact that Europeans also are fallible, and their methods not beyond criticism.

You do not seem to be aware, Mr. Editor, of the fact that appropriations for the investigation of the contagious diseases of animals have been made on a liberal scale for the past six years, and that a considerable part of this money has been used in the study of micro-organisms. The results of these investigations have been so satisfactory to the people at large and to congress, that a permanent bureau was established at the last session, a part of the duties of which is to continue this line of research. I have had a laboratory and an experiment-station under my direction in Washington for more than a year. And while I am willing to admit fallibility and imperfections, if one can judge from scientific articles and from the reports of those who have visited the laboratories of Koch and Pasteur, I see no reason why we should fear a comparison of our laboratory, apparatus, and methods, with those in use on the other side of the water.

It is true that the enormous development of our animal industries brings up a multitude of inquiries foreign to the subject of micro-organisms, which

¹ Department of agriculture, Annual report, 1881 and 1882, pp. 283-300.

² Department of agriculture, Annual report, 1883, p. 48.

³ *Ibid.*, 1881 and 1882, pp. 285-288; also 1883, pp. 44-49.

⁴ *Ibid.*, 1881 and 1882, p. 288.

⁵ *Ibid.*, 1881 and 1882, p. 288.

⁶ *Ibid.*, 1881 and 1882, pp. 283, 284.

⁷ *Science*, iii, p. 155.

¹ Department of agriculture, Annual report, 1880. *Ibid.*, 1881 and 1882, pp. 272-306. *Ibid.*, 1883, pp. 44-52.

² Les organismes vivantes de l'atmosphère (P. Miquel, Paris, 1883), footnote, pp. 154, 155. Department of agriculture, Annual report, 1881 and 1882, p. 264.

divides the time of the director, and distracts his attention; but we are endeavoring to overcome these difficulties by a division of labor; and when the new bureau is fairly organized, and running smoothly, we hope, if not to satisfy all, at least to keep adding to our knowledge of animal contagia until we are able to combat them successfully.

A few weeks ago, in a review of the last report of the department of agriculture (*Science*, iii. pp. 689, 690), you took occasion, while speaking very kindly of the work that had been done, to intimate that the proposed investigations for the discovery and supply of vaccine to be used in preventing contagious diseases were uncalled for and useless; the argument being that the profession could be relied upon to prepare and apply such vaccines if they were of sufficient value.

In reaching this conclusion, you evidently left out of consideration the most important elements of the problem. In the first place, we have but a mere handful of veterinarians in the whole country, and these mostly located in cities where they are of little use in treating the diseases of meat-producing animals: in other words, the stock-raisers of the country are practically beyond private veterinary assistance, and will remain so for years to come. In the second place, there are not more than two or three veterinarians in the country who have had the training, or, indeed, who have any conception of the processes, necessary for the study and cultivation of the group of organisms to which the disease-germs belong. You admit more than this in the editorial to which I referred in the first part of this communication. In the third place, there is nowhere in this world a single man who can tell the exact conditions under which the germs of the diseases that are most dangerous in this country must be cultivated so that they will be safe as vaccines, and at the same time capable of conferring a certain immunity. This must be worked out by long and costly experiments; and surely no individual is likely to be found who will attempt so difficult and dangerous a service at his own expense. In the fourth place, you will observe that even those medicines of which the processes of manufacture are tolerably well known (such as quinia and nitrite of amyl, for instance) are produced by chemists, — specialists, — and not by the medical profession. How much more necessary would it be, then, for specialists to control such delicate manipulations and complicated apparatus as are required in the reproduction of uncontaminated germs, especially when these are to be held at a given point in the scale of virulence. But how can you ask our people to depend upon such specialists in one number, and within a month or two assure them that there is no one in the country who is doing work of value in this direction? If you turn your eyes to Germany, you will see Koch, as a government official, using national appropriations to study the organisms which produce the diseases of men and animals. Turn to France, and you see Pasteur, also by the help of the government, endeavoring to discover methods for the production of vaccines that may be used to prevent animal diseases. Do you see the unassisted veterinary profession in either country accomplishing any thing in this direction, though they vastly excel ours both in numbers and education? Why, then, should not the officials of our government do the same kind of work, and strive to attain the same ends? And, if supplying vaccines to our farmers should prove the most economical and satisfactory means of fighting certain contagious diseases, why should not the agricultural department furnish such vaccines?

Finally, if you are right in your supposition that "there must be some misconception lurking in the minds of the department officials, if they really suppose that the veterinary profession is necessarily incompetent to deal with a problem because, forsooth, the known methods of solving it happen to be delicate and expensive," I would like to ask how it happens that the animal plagues of this country are increasing their ravages from year to year without an effort, on the part of the veterinary profession, to hold them in check? If 'an ordinary citizen' supposes that our future is likely to be different from our past in this respect, he certainly shows a surprising ignorance of the methods that have been found necessary in every country where any success has been achieved.

Is it not our duty to accept great national problems as they actually exist, rather than in the shape they are pictured by the distorted imagination of the editorial philosopher, who comes in contact with germ-diseases in books and periodicals, but never sees them on the farm and the ranch, where their ravages amount to millions and tens of millions of dollars annually?

In closing, permit me to express my personal disappointment at the course which the editor of *Science* has decided to adopt in regard to this branch of our home work. It was expected that this periodical would be a true representative of American science, defending its conquests, and encouraging its workers to renewed exertions. With certain departments it has not failed to do this; but with others, as I trust I have shown in this communication, its only effect has been to discourage and discredit when honest and successful work was being accomplished; and in saying this, I know I am not alone in my opinion, for a number of well-known scientific men have recently expressed to me the same idea.

If, Mr. Editor, this communication is open to the charge of egotism and garrulousness, I hope it will not be forgotten that the American investigator who is overburdened with modesty stands but a poor chance in the struggle for existence with the conditions of environment so decidedly against him.

D. E. SALMON.

[We have but to repeat, that "work of value upon the subject of micro-organisms is not done in this country." If all work upon micro-organisms that any observer chooses to publish — the result of unskilled labor — is of value, then we have doubtless cast an unwarranted slur upon American investigators. If, on the other hand, only that work is of value in this field which is the result of untiring industry, long training, and judicial criticism, then our remark was just. To be of value, such work must be *complete* in all its details; and the relationship between a bacterium and a pathological process must be established beyond a reasonable doubt, provided the methods are correct, and there has been no error of observation. It remains to be seen whether American work of permanent value in this branch of research will not receive the same hearty recognition from our co-workers abroad as it has in all other branches where our excellence has deserved acknowledgment. In conclusion, we wish to state that we do not care for controversy, nor did we intend to excite it. It was our belief, that, on the whole, we have not yet thoroughly mastered all the requirements necessary for this most delicate branch of investigation, and that a reminder of that fact would do no harm. We sympathize with unrecognized merit, but would console it with the reflection that *Aucun chemin de fleurs ne conduit à la gloire.* — ED.]

THE WORK OF OCTAVE HALLAUER.

THE distinguished physicist and engineer, G. A. Hirn, sends to the writer from his sick-bed, where he has been lying, as his amanuensis pathetically writes, '*malade depuis plus d'un mois*,' a biographical sketch of his hardly less distinguished and talented assistant, Octave Hallauer. This paper was read before the Société industrielle de Mulhouse on the 30th of January last. Mr. Hallauer died on the 5th of December, of typhoid-fever. He was born at Metz, Jan. 21, 1842, was educated there, and received the degree of bachelor of science in 1860. He continued his studies in mathematics, and entered the technical school at Mulhouse at the age of twenty, making a specialty of applied mechanics. He became, at his graduation, an 'apprentice-engineer' at Bitschwiller, in the establishment of Stehelin, and afterward joined Leloutre, the agent of the house of Grafenstaden, as his aid and secretary, at Mulhouse. Later, he became the assistant engineer of the Association des propriétaires d'appareils à vapeur, and afterward, January, 1875, the engineer of the Messrs. Hartmann.

During the Franco-German war, Hallauer served with the French as a lieutenant, and fought in the armies of the Loire, of Orleans, and other sections of the French army of defence. He was present in the deadly fight at Villersexel, and, after the defeat of the army, took his forces across the Jura Mountains, and retired to Lyons, where he arrived, sick and exhausted, with the portion of his command thus saved. Recovering his health, he resumed, at the close of the war, his professional work.

During the campaign, and at intervals, as opportunities offered, Hallauer frequently varied the more serious work which came to him, by the practice of an accomplishment in which he excelled,—that of the painter. His sketch-book was filled with studies of the beautiful scenery of the district in which occurred the operations in which he was engaged.

The long series of experiments upon the steam-engine in which Hallauer engaged, and which have made him famous, were commenced in 1868. The history of the development of the theory of the steam-engine (which now, thanks to the investigations of such men as Hallauer, is at last likely to become soon satisfactorily complete) may be divided, according to Hirn, into three distinct periods: 1°. That in which it was assumed that the heat entering the motor simply traversed the system, unchanged

in amount, and acting only by its 'head,' as in the case of falling water, finally reached the condenser without loss in quantity,— simply lowered in temperature, and hence, in head available for purposes of impulsion; 2°. That in which it became recognized, that, in addition to the necessary depression of temperature, there is always, also, an actual loss of heat by transformation into mechanical energy; 3°. The experimental period,— that in which it at last became known that the heat supplied to the engine, in addition to these two changes, becomes seriously modified in its availability by its interaction with the walls of the steam-cylinder; which surfaces take up heat from the entering steam, and transfer it to the exhaust side without deriving from it useful effect.

The first period dates from before the time of Carnot. The second period was opened in 1852 by the labors of Clausius and of Rankine. The third period has only been entered upon within a few years past, the experiments of Hirn and Hallauer having furnished a very important part of the basis for the new treatment of the subject. The writer would distinguish these two later periods as those of the 'ideal' and of the 'real,' in the theory of the steam-engine. Clausius and Rankine, and other writers on the theory of heat-engines, have usually taken no cognizance of the expenditures of steam, other than those involved in the thermodynamic relations of energy, and ignore the usually greater demand for steam to supply wastes of heat in the steam-cylinder by the processes now familiar to every engineer, as invariably occurring in every heat-engine,— those caused by 'cylinder-condensation' and leakage. The latter can be prevented: the former may be ameliorated, but can never be wholly prevented, and will probably rarely, if ever, be reduced to such an extent that it may be neglected in the theory of the engine. It usually takes place to such an extent as to render the values of efficiency of fluid, and of engine, and of estimated 'duty,' obtained by the purely thermodynamic treatment, far from correct, and often very absurd. This fact has in many cases induced practically expert engineers to regard the current works on thermodynamics as devoid of value and practical interest, forgetting that the correct statement and application of one set of natural laws never can be valueless, even when, as here, other laws may be implicated in the same set of phenomena; which may be equally essential to a complete and correct theory, and which laws may be less well determined, and their operation less precisely understood. The first essential step

having been taken, it becomes a duty, not to ignore that, but to seek the knowledge needed before the next step can be taken. In this department also, as in others, the theorist has often failed to realize, that, although his mathematically deduced conclusions indisputably follow from his assumed premises, the latter may be, nevertheless, so far different from the conditions of actual work as to render his deductions practically valueless and absurd.

The last-mentioned of the two classes of phenomena are now becoming well recognized as essential elements in the action of all heat-engines, and it will not be long before investigators now at work will bring into view all the facts needed in the task of tracing out the laws controlling this method of expenditure of heat; and its introduction into the theory of the steam-engine will promptly follow. The writer has already endeavored to frame a closely approximate theory of the steam-engine on this basis, using the facts already known, and taking expressions for this method of waste which experiments already made indicate to be tolerably exact; sufficiently so to permit their use in design until further research shall

give us more precise, though perhaps less convenient, expressions. The results so attained accord very satisfactorily with experience. This last period in the history of the theory of heat-engines has been inaugurated by the

very valuable labors in Great Britain of Professor Cotterill, who seems to have been the first author to take up the new phase of the subject with the intention of making practically useful application of existing knowledge; and, on the continent of Europe, by the interesting, if somewhat warm, discussion of the defects of the theory of the second period, between Messrs. Hirn and Hallauer, on the one hand, and Professor Zeuner, on the other; and also, in this country, by the attempt to rationalize the accepted theory to which allusion is made above.

The experiments upon which we are

to-day dependent in this work of revolutionizing the theory of heat-engines, and which have revealed the limitations to which the economical application of heat as a motor in the steam and other heat engines is subject, began with James Watt, who a hundred and twenty years ago, by his investigation of the action of steam in the cylinder of the Newcomen engine, revealed



O. Hallauer

the fact and the importance of that waste by cylinder-condensation which is only to-day becoming recognized as an essential element in the theory of the 'real' steam-engine of the engineer, as distinguished from the 'ideal' engine of the authors of the theory of thermodynamics, and which is recognized as imperatively demanding consideration, if that theory is to be made of practical use in engineering. Watt's discovery of this 'cylinder-condensation' led him to the invention of his separate condenser, and of the long-neglected but now familiar steam-jacket, — an attachment which was, for many years, only seen upon the Watt or Cornish engine, and was almost never used elsewhere. It has now come in with the compound engine, and is familiar to every engineer. Watt also found that this action placed an early limit to the gain derivable by expansion.

The work of Watt in the systematic experimental study of the steam-engine was not taken up by his successors in the profession until about the beginning of the present half-century, or a little later, when Hirn in France, and Isherwood and the navy department in this country, began the work which has now become classic. Defective as some of this earlier work may be by some regarded, it was of inestimable value; and Hirn, and his assistant and colleague, Hallauer, will never be forgotten as prominent among the pioneers in this all-important line of research. Mr. D. K. Clarke of Great Britain, one of the first of the new race of engineers, interested alike in theory and in experiment, familiar alike with the science and the practice of engineering, must be placed beside these investigators as having persistently called attention to the loss of energy revealed by them, and by his own investigation of the wastes occurring in the steam-cylinder of the locomotive. This work began, in his case, as long ago as 1855.

Hallauer was one of the first to recognize, and frankly to admit, the defects of the 'ideal' treatment of the theory of the steam-engine, and was as prompt in his acceptance of the inevitable as was his preceptor. As Hirn says, breaking away from the old system, his progress was rapid and satisfactory. Seizing with avidity experimentally determined facts, he held fast to the knowledge thus acquired, and demanded that theory should precisely conform to fact. His work upon the compound engine was especially fruitful; and his knowledge of theory, and his skill in its application, rendered his work at once available. He studied also the data given him by Widmann, relative

to the performance of marine engines, and deduced, from his examination of the phenomena here revealed, the proper methods of increasing their efficiency. Uniting, in a rare degree, the practical sense with the intellectual cast of mind of the scientific man, he was able to make his work immediately and most effectively useful.

Referring to his personal character, Hirn describes him as possessing the most admirable qualities. Kindly, affectionate, modest, and yet intellectually great, Hallauer united with these prepossessing characteristics the most irrepressible energy and mental force. The last words in the eulogy by his friend Hirn are those of personal regard and of deepest affection.

Hallauer wrote many papers,¹ the first being an account of the method adopted by Hirn for determining the quality of steam by means of the calorimeter. The greater number were descriptive of his experimental investigations. He was an honorary member of the Société industrielle de Mulhouse, and of the American society of mechanical engineers, and was a member of the Société des ingénieurs civils de Paris. The writer wishes to add to the eulogy of Hirn, if it be possible to so add to it, this tribute of kind remembrance of one who, even were he not so distinguished a colleague in the professional fraternities, would none the less demand the most earnest expression of admiration, esteem, and respect.

ROBERT H. THURSTON.

THE SYNOPTICAL FLORA OF NORTH AMERICA.

THE second portion of Professor Gray's 'Synoptical flora of North America' has appeared, six years after the publication of the first part, which contained the gamopetalous orders following Compositae. The present instalment of this important work — the most important contribution (with the exception, perhaps, of the *Genera plantarum* of Bentham and Hooker) made in late years to systematic botany — treats of the plants of North America (exclusive of Mexico) belonging to the families which precede those elaborated in the previous volume, which took up the 'Flora' where it was left more than forty years ago, at the end of the second volume of Torrey and Gray's 'Flora.' The present publication is devoted to an elaboration of the families (Caprifoliaceae to Compositae) embraced in the second volume

¹ Published by Gauthier-Villars, Paris.

of the old 'Flora,' and is therefore in a certain sense a new edition of that work, although entirely recast and rewritten.

The present volume is of special importance and value. Its publication has long been looked for with impatience, and its pages will be examined with the deepest interest by all students of American botany. It contains the mature views of the most acute and profound student of the great and difficult order of Compositae, to which not less than one-eighth of all the flowering plants of North America must be referred, — an order, as represented on this continent, to the comprehension of which he has given his best efforts and unflagging industry for more than half a century, and which, it is safe to predict, no other botanist would ever have been able to so elucidate. The plants, belonging to 5 families, 274 genera, and 1,767 species, are characterized in this volume, which contains, exclusive of its very full index, 446 pages, of which all but about 50 are devoted to Compositae, with 237 genera and 1,610 species.

A brief and necessarily imperfect comparison of the families here elaborated, as represented in this country at the present time, with what was known of them when the second volume of Torrey and Gray's 'Flora' appeared, between 1841 and 1843, will show the extent and character of the work which has occupied Professor Gray of late years, and the importance of the service which he has performed, as well as the zeal and industry of the botanical travellers and explorers who have long been busy, under his general direction, in all parts of the country.

Adoxa, transferred from *Araliaceae*, now appears, represented by its single widely distributed species, among *Caprifoliaceae*. Additions to *Sambucus* are *S. melanocarpa* (of the northern Rocky Mountains) and *S. Mexicana* (a Mexican species of the boundary and of southern California). The Texas station, near San Antonio, of this tree, is not given. In *Viburnum*, *V. densiflorum* — a southern species, as Professor Gray remarks, too near *V. aurifolium* — is admitted. *Symphoricarpos*, a North-American genus, is increased by a new, long-flowered section with three species, of the south-western mountains: *Lonicera conjugalialis* of the Sierra forests of California, and *L. Utahensis* of the northern Rocky Mountains and Utah, are additions to that genus which shows besides many important changes in the rank and position of various species. Important changes appear in *Rubiaceae*. *Loganieae*, which appeared in the old 'Flora' as a tribe

of this order, is now placed as a family between *Asclepiadaceae* and *Gentianaceae*, in the preceding volume. *Borreria* is reduced to *Spermacoce*; and *Hedyotis* is split up among *Houstonia*, *Oldenlandia*, and *Pentodon*. Besides these changes, eight genera not in the old 'Flora' are represented by plants, mostly of West-Indian or Mexican origin, which recent explorations have brought to light in southern Florida and along the Mexican boundary. *Kelloggia*, a monotypical genus of the Pacific slope, commemorates the botanical labors and zeal of Dr. Albert Kellogg, one of the early explorers of California botany. The large genus *Galium* is increased from eighteen to thirty-seven species.

In *Valerianaceae*, *Plectritis* and *Fedia* are merged in *Valerianella*, while the species of *Valeriana* are increased from six to eight.

The extension and changes in *Compositae* during the last forty years, as was to have been expected in a family so largely represented in our flora, and of such wide and general distribution, far exceed, in number and importance, the changes in the smaller orders alluded to above.

This order, as represented in North America at the time of the publication of the old 'Flora,' was grouped in eight tribes: in the new elaboration, representatives of eleven tribes appear. It now contains representatives of 237 genera and 1,610 species; while forty years ago there were, within the limits of the region embraced by Torrey and Gray's publication, only 199 genera and 1,011 species. Of the large genera, *Aster*, which Dr. Gray remarks "is far the most difficult of our genera, both from the settlement of the names of the species and from their limitation, in respect to which little satisfaction has been obtained as the result of long and repeated studies," heads the list with 124 species, — seven less than the author's elaboration of this genus for the old 'Flora.'

This diminution of species is due to the fact that several of the Linnaean species have been dropped, from one cause or another, and because *Aster*, largely a genus of eastern America, has not received many additions through western explorations. The same remarks are true, too, of *Solidago*, our second largest genus of *Compositae*, now represented in our flora by 74 species, although not less than 94 were admitted in the old 'Flora.' Some species have been dropped entirely, and others reduced to varieties; while few new additions to the genus have been made. *Erigeron*, on the contrary, has been nearly doubled, increasing from

40 to 71 species. *Bigelovia*, which fifty years ago had a single representative in the Atlantic states, now, as extended, contains 19 species, with its centre of distribution beyond the Rocky Mountains; whence, of late years, have come, of course, the principal additions to our flora. Similar comparisons might be made indefinitely between the composition of our flora as now understood and that of the earlier part of the century, were such comparisons necessary to illustrate the importance of the work under consideration, or to impress upon our readers the sense of our obligations to its author. Were it necessary or proper to say any thing at this time in regard to the part played by Professor Gray in the development of botanical science in this country, it would only be necessary to point to the fact, that, of the North-American Compositae as enumerated in this volume, more than 600 species and 30 genera have been characterized and enrolled by him since the publication of his previous study of the order. Twenty-eight species are first described in this volume.

The present volume, like its predecessor, will be found a model of comprehensive arrangement, and neat, concise, and clear expression. Unlike its predecessor, it bears upon the titlepage, in addition to the names of Professor Gray's New-York, London, and Leipzig publishers, "Published by the Smithsonian institution, Washington," where copies, no doubt, can be obtained, as well as from the author at Cambridge.

THE LANGUAGES OF AFRICA.

A sketch of the modern languages of Africa; accompanied by a language-map. By ROBERT NEEDHAM CUST. London, *Trübner*, 1883. 2 vols. 16+566 p. 8°.

THE Caucasus is styled in the east, from the variety of idioms spoken by the many tribes that are harbored in its recesses, the 'Mountain of languages.' This variety, remarkable as it is, becomes insignificant when compared with that which exists in Africa, which might well be called the 'Continent of languages.' In these volumes of Mr. Cust, we read of no less than five hundred and ninety-one distinct idioms, of which four hundred and thirty-eight are classed as languages, and a hundred and fifty-three as dialects. And even this does not complete the list; for there are several unexplored regions, of whose tribes and languages nothing certain is known.

A closer scrutiny, however, lessens the mar-

vel materially. Of the idioms enumerated, no less than two hundred and forty-eight belong to that portion of the continent which lies south of the equator. All these idioms, as is well known, compose only two linguistic stocks, — the great Bantu family, which occupies the whole of the wide territory explored by Livingstone and Stanley; and the Hottentot-Bushman family, comprising the tribes of dwarfish people who seem to have been the aboriginal inhabitants of South Africa. The Bantu nations now speak, according to Mr. Cust, two hundred and twenty-three languages and dialects. But as philologists have no doubt that all the idioms of the Indo-European stock are the offspring of a primitive mother-tongue, which was at one time spoken by a single tribe, and earlier still by a single household, so we may feel assured that all the languages of the Bantu family have their origin in the speech of a single clan.

There was reason to hope that in Mr. Cust's elaborate work we should find this process of reduction continued, and the vast variety of African tongues brought into the manageable compass of a comparatively few linguistic stocks. This expectation, unfortunately, is not fulfilled. Mr. Cust has chosen to adopt the classification of the eminent ethnologist, Prof. F. Müller, who arranges the languages (or, more properly speaking, the tribes) of Africa in six main divisions, — Semitic, Hamitic, Nuba-Fulah, Negro, Bantu, and Hottentot-Bushman. This arrangement, however, was proposed by the distinguished Viennese professor, not for linguistic, but mainly for ethnological, or rather anthropological, reasons. Only three of these divisions — the Semitic, the Bantu, and the Hottentot-Bushman — are true families. The other three divisions are styled by Mr. Cust, 'groups,' — a word which in comparative philology has, at least as here employed, no scientific meaning whatever. The connection of the tribes composing these groups is not even geographical: it depends merely upon some physical resemblances; and these, it may be affirmed, are not nearly so strong as those which exist between the Hungarians, the Germans, and the Basques, whom no philologist would think of classing together. In fact, the word 'group' in this case is simply, as Mr. Cust frankly admits, a confession of ignorance.

The ignorance which is thus confessed is, on the author's part, to a large extent voluntary. With the immense mass of linguistic materials which he has collected, and which far surpasses all that earlier inquirers have been able to accumulate, nothing would have been more easy

than by a simple collation of vocabularies — aided, where practicable, by grammatical comparisons — to ascertain the relationship of the various idioms, and to reduce them into the families to which they belong. It is probable enough that some isolated languages would be found, like the Basque in Europe and the Khasi in farther India, whose kinship could not at present be determined; and, of course, the 'language-map' would show many vacancies: but these are imperfections which belong to the earlier stages of all investigations. In spite of such drawbacks, a scientific classification could have been made, which would have gone far to bring this linguistic chaos into order, and would have thrown a flood of light upon African ethnology.

But while regretting these deficiencies in Mr. Cust's work, we must be thankful for what we have gained from him, which is not a little. In these two volumes we have a clear and readable account of the present state of African philology, and a complete list of the tribes and languages of the continent, so far as they are now known, with interesting details concerning many of them. The names of all the authors who have written on the subject, and the titles of their productions, are given with commendable fullness and precision. The work displays great industry and conscientious accuracy. The extensive 'language-map,' which has evidently been prepared with much care, aids materially in illustrating the text, and is in itself a most valuable contribution to philological science. In spite of the defects which have been indicated, Mr. Cust's treatise must be pronounced to be by far the best work which we possess on the subject to which it is devoted. Scholars who pursue this important branch of linguistic study will find in these attractive volumes a highly useful, and indeed almost indispensable, guide. H. H.

MINOR BOOK NOTICES.

The development theory: a brief statement for general readers. By JOSEPH Y. BERGEN, jun., and FANNY D. BERGEN. Boston, Lee & Shepard, 1884. 7+240 p. 24°.

No better evidence of the present general interest in biology could be wanted than is afforded by the growing demand for popular books on evolution. The latest of these is a little treatise of two hundred and forty pages, by Mr. and Mrs. Bergen, in which, to be sure, not much is original, except the form in which the facts are presented, and a few of the examples cited, as the authors confess; but a read-

ing of their book shows that they have given a good deal of thought to the presentation of the chief arguments upon which the modern development theory rests, with so few technicalities as to render it comprehensible to even young readers. With so many books of a similar character already in circulation, only the test of time can show whether this latest one meets, as the authors intended, a real need. So far as one not wholly unfamiliar with the subject can judge, the story is well and simply told.

Calcul des temps de pose et tables photométriques. Par LÉON VIDAL. Paris, Gauthier-Villars, 1884. 114 p. 16°.

THIS little book is made up very largely of tables, whose object is to enable the photographer, when supplied with a particular form of photometer, to give the correct exposure to his plate under all circumstances. The book is apparently written largely for amateurs in landscape-photography; but whether they will in general be willing to trouble themselves to procure such a photometer, and carry round the tables with them to consult whenever they wish to take a picture, in preference to relying on their judgment, is perhaps questionable. The photometer employed is similar to that used by carbon-printers, depending on the exposure of sensitized silver-paper, and the noting of the tint obtained after a definite time. The author refers to the application of the instrument to the case of enlargement, where it would seem to be more useful than when taking the original negative. There is one serious objection to its employment for the latter purpose, however, which our author seems to have overlooked. This is, that the exposure for a given landscape does not depend wholly on the total amount of light coming from it. If the background is the important portion, a certain definite exposure will be given. If, on the other hand, it is the foreground that is of interest, the same view may require two or even three times the exposure under the same conditions.

Leidraad bij het onderwijzen en aanleeren der dierkunde. Door Dr. JULIUS MACLEOD. Algemeene dierkunde. Met eene titelplaat en 61 door den schrijver gegraaverde figuren. Gent, 1883. 151 p. 12°.

THE author of this little school-book has written it in the Dutch language, in the patriotic belief that *dierkunde*, or zoölogy, may be taught in that tongue, which can supply all the necessary terms. The volume is really a

protest against the custom in Belgium of using so many French text-books. He carefully avoids all except real Dutch words: so we have *borstpijp* ('thoracic duct'), *tuschenwervelig* ('intervertebral'), etc., all of which are gathered into an alphabetical list at the end of the volume, where their French equivalents are also given.

The book is devoted almost exclusively to the anatomy and physiology of man as illustrating the general principles of animal life. The author's presentation of the rudiments of his science is excellent; but his illustrations, white lines on a black ground, are neither very clear nor always accurate.

ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS OF THE UNITED STATES.

At a meeting held in Philadelphia, Sept. 8, to consider the formation of a sub-section of agricultural chemistry of the American association, it was deemed inadvisable to apply to the standing committee; but a committee was selected to report a plan for the formation of an association of chemists who are engaged in the analysis of commercial fertilizers.

The committee's report, which was adopted, recommended that the Association of official chemists of the United States should be organized. To membership in this society, chemists of departments of agriculture, state agricultural societies, and boards of official control, are eligible; and each of these organizations is entitled to one vote, through its properly accredited representative, in all matters upon which the society may ballot. All chemists are invited to attend the meetings, and take part in the discussions, without the right to vote. The affairs of the association are managed by an executive committee of five, including a president, vice-president, and secretary (who acts as treasurer). There are also three standing committees, on the determination of phosphoric acid, nitrogen, and potash. They will distribute samples for comparative work, and report the results at the annual meeting, which takes place on the first Tuesday in September of each year, or at any special meetings which may be called.

After the acceptance of the constitution, the following officers were elected: President, Prof. S. W. Johnson of Connecticut; vice-president, Prof. H. C. White of Georgia; secretary and treasurer, Dr. C. W. Dabney, jun., of North Carolina; members of the executive committee, Dr. E. H. Jenkins of Connecticut, Dr. H. W. Wiley of Washington. The presiding officer then appointed the following members of the standing committees: On phosphoric acid, Dr. E. H. Jenkins of Connecticut, Dr. H. C. White of Georgia, Dr. W. C. Stubbs of Alabama; on nitrogen, Mr. P. E. Chazal of South Carolina, Dr. A. T. Neale of New Jersey, Prof. J. A. Myers of Mississippi; on potash, Dr. H. W. Wiley of Washington, Mr. J. W. Gascoyne

of Virginia, Mr. Clifford Richardson of Washington.

It was voted to adopt provisionally the Atlanta method for the determination of the various forms of phosphoric acid, involving the use of the usual neutral citrate solution at a temperature of 65° C. for a half-hour. The recommendations of Dr. Jenkins in regard to potash estimation were accepted; and Mr. P. E. Chazal of Columbia, S.C., was directed to have the proceedings and methods of the association printed for distribution among those who are interested in the subject.

THE AMERICAN HISTORICAL ASSOCIATION.

IN response to a call issued by Gen. Eaton and F. B. Sanborn of the Social science association, and by Professors Adams of Ann Arbor, Tyler of Cornell, and Dr. H. B. Adams of Baltimore, about twenty writers, students, and teachers of history in this country met at the United States hotel, Saratoga, on the morning of Sept. 9, and decided to form an independent organization for the advancement of the scientific study of history on this continent. Among others present at this and later sessions, were President White of Cornell; Charles Deane, LL.D., of Cambridge; Justin Winsor, librarian of Harvard university; General Walker of the Massachusetts institute of technology; William B. Weedon of Providence; Clarence W. Bowen of the New-York *Independent*; Professors C. K. Adams of Ann Arbor, Tyler, Crane, and Tuttle of Cornell, Austin Scott of Rutgers, Emerton of Harvard; Associate-professor H. B. Adams of Johns Hopkins; Dr. Channing and Dr. Francke of Harvard. Justin Winsor was elected temporary president, with Dr. H. B. Adams secretary.

In the afternoon President White of Cornell delivered the opening address in Putnam hall. He advocated a broader treatment of historical topics than is at present followed. Not that he undervalued the work of the specialist; but he thought that a view of the historical work now going on in the world showed the necessity of connecting critical analysis, on the one hand, with a synthesis of results on the other. Instruction in history, which is growing of more importance every day, should include both methods. He severely criticised Herbert Spencer's theory of historical study as confounding a mere search for statistics with the real study of the forces of civilization.

Professor C. K. Adams read a long paper, written by one of his pupils, in which the actions of several western states with regard to the lands which the nation had given them for purposes of collegiate education were most justly denounced.

Wednesday morning another session was held, at which a constitution was adopted, and permanent officers elected: Andrew D. White, president; Justin Winsor and C. K. Adams, vice-presidents; H. B. Adams, secretary; and C. W. Bowen, treasurer. The affairs of the association were confided to the care of an executive council consisting of the above *ex officio*,

and Charles Deane, Moses Coit Tyler, W. B. Weeden, and Ephraim Emerton.

Dr. Edward Channing of Harvard college then read a paper in which he maintained that the early settlers of the English North-American colonies did not leave behind them the experience in the management of local affairs which they had inherited from their ancestors, and which formed one of the most precious inheritances of the English race; but that they brought such experience to this country, and there applied it so far as the peculiar conditions of their environment would permit. He further said, that he thought the English common-law parish of 1600 was the most important connecting link between the institutions of the English race in their two homes; and he gave some examples of this connection. Dr. Charles Deane gave the pith of the argument advanced by Judge Aldrich, at a recent meeting of the Antiquarian society, that the New-England town system was but a legislative creation. Dr. H. B. Adams said that in his opinion there was not one institution of early New England which did not have its analogue in the institutions of old England, and he thought that the author of the paper under discussion had found the connecting link. Judge Chamberlain of the Boston public library endeavored to show that the two theories were not inconsistent, and likened the experience that the New-England fathers had brought with them to a grain of English wheat, which when planted in our soil reproduced its kind so far as circumstances would permit. President White, in closing the discussion, remarked that he considered the paper an example of the union of the analytic and synthetic methods which he had advocated.

Mr. C. H. Levermore of Johns Hopkins then read an able essay on the founders of New Haven, — John Davenport and Theophilus Eaton, — who had strengthened class distinctions at the outset in their colony, and had created a ruling caste of Brahmins.

Prof. T. M. Crane of Cornell described some new sources of mediaeval history which he has recently opened up. He thought the field would be an attractive one, both from the large amount of new material, and also from the new methods applied to old material such as local traditions, popular songs, and folktales, which often contained details not to be found in written history. A still more curious source was the collections of stories with which the preachers of that time enlivened their sermons; each in itself of little value, but forming, *en bloc*, invaluable material for the historian. This new method of study would re-act most favorably upon the study of our own history, and encourage the collection of local traditions, folk-songs, and tales; of which an excellent beginning has been made in Allen's Slave songs of the South, and Newell's Songs and games of American children. President White spoke of the importance of Professor Crane's work, and then introduced Dr. Francke of Harvard college; who described the founding and progress of the *Monumenta Germaniae*, with which he had been associated for two years. Justin Winsor closed the session with an account of the Narrative

and critical history of America that he is now editing, and of which two volumes are already printed although not published.

At a public session in the afternoon, Professor Tyler of Cornell presented a rather commonplace and eulogistic paper upon the influence of Thomas Paine on the declaration of independence; and Professor Austin Scott — formerly associated with George Bancroft — read an essay on the constitutional development of the United States. The intense heat interfered with the author's delivery, and also with the taking of notes; but it may be said that the author maintained that what he termed the federative principle was the key to our constitutional history, and he traced its action with great care and detail through the successive periods of our national growth. It is to be hoped that Mr. Scott will still further elaborate and publish his paper, which showed considerable ability and thought.

NOTES ON THE ELECTRICAL CONFERENCE.

THE Electrical conference, called together by the commission appointed by the president of the United States, met in Philadelphia on Monday, Sept. 8, and continued its sessions throughout the week. The first meetings were held in the lecture-hall of the Electrical exhibition; but on account of the bad acoustic properties of that room, the sessions after Tuesday took place in the hall of the Franklin institute.

About one hundred and seventy-five delegates were invited by this commission to be present, and constitute the conference. Of these the greater number were American investigators and electricians, but a number of foreign conferrees were also included. Of these it should be mentioned, that there were present Sir William Thomson, who was also vice-president of the conference; Professor Fitzgerald of the University of Dublin; Professor Oliver Lodge of Liverpool; Mr. W. H. Preece of the English postal telegraph; Professor Arthur Schuster of Manchester; and Professor Silvanus P. Thompson of University college, Bristol.

The conference was designed to be representative of all interested in progress in electrical knowledge; and so not only were those present who are more concerned with the purely theoretical questions involved, but also those especially occupied in developing applications of electricity.

Prof. Simon Newcomb, on behalf of the commission, opened the conference in a brief address of welcome, and also stated the objects for which the conference had been called. He was followed by the president of the conference, Prof. Henry A. Rowland, who delivered a carefully prepared and very interesting address, in which were discussed, among other things, the interdependence of applied and pure science, some of the questions still open in electrical science, and the need of more careful training in the *theory* of electricity in technical schools.

Sir William Thomson then made a short address, after which the conference adjourned to meet on Tuesday, when the regular discussions were begun.

The object of the conference was to take authoritative action respecting the electrical standards recommended by the international convention; to consider the advisability of recommending the establishment by the government of a bureau of physical standards; to consider what could be done by the U. S. signal-service, with the co-operation of the various telegraph and telephone companies, towards increasing our knowledge of atmospheric electricity and earth-currents; and to discuss subjects in which the knowledge possessed by those acquainted with the theory of electricity could be brought to the aid of those engaged in the applications of the science. The sentiment of the conference was in favor of adopting the electrical standards recommended by the international convention which met at Paris last April; but, as considerable difference of opinion exists as to the best standard of light to be adopted, the whole subject of the electrical standards was referred to a committee which is to report to the commission within three months. In the discussion of the adoption of the legal ohm, as defined by the Paris convention as the resistance of a column of pure mercury at zero degrees centigrade, of one square millimetre cross-section and one hundred and six centimetres in length, it was brought out that the results obtained in the experiments which have been carried on during the past year under Professor Rowland's direction, give very nearly 106.28 centimetres as the length of the column of mercury which represents the *true* ohm.

The subject of the best methods of extending our knowledge of atmospheric electricity and earth-currents, and any possible relation that may exist between them and the weather, was introduced by Professor Abbe of the signal-service. He represented the importance of the subject, and that by using suitable methods, and by the co-operation of the various telephone and telegraph companies, much valuable information might be obtained, and without interfering with the regular work of the lines employed. Sir William Thomson called attention to the fact, that in the study of earth-currents the quantity to be measured is the difference of potential between the points of observation. By such measurements the distribution of potential at any time over the country examined may be mapped and studied.

The question of the establishment of a bureau of physical standards was introduced by Professor Snyder, who pointed out the advantages which would result from having physical standards preserved and verified under government supervision. Work which is now being done by different observers all over the country, and in a way which is often necessarily incomplete from the lack of funds, could thus be done at a central laboratory, more cheaply, effectively, and accurately; and thus the physicists now engaged in these laborious determinations and comparisons would be free to occupy themselves with investigations looking to the discovery of new truth. In the discussion

which followed, Professor Rogers of Cambridge, Mass., urged that the bureau should engage in auxiliary research, and showed how this was necessary for the accurate establishment of units. Lieut. Allen of the signal-service read a paper giving an account of the success that had attended the work of that department in obtaining accurate standards for thermometry and barometry. Professor Hilgard, superintendent of the U. S. coast-survey, was not in favor of such a bureau, on the ground that it would discourage private research, and that the present bureau of weights and measures met every requirement. Professor Simon Newcomb spoke in favor of the proposed bureau; and Sir William Thomson not only favored the idea, but thought that instruments of the accuracy required by such a bureau for its work would soon be devised and constructed, and the time was therefore ripe for such action to be taken. Finally the conference adopted a resolution to the effect that it deemed it of national importance that Congress should fix standards of electrical measures, and establish a bureau charged with the duty of examining and verifying instruments for electrical and other physical measurements. The commission was urged to bring the matter before congress; and it was left with them to decide upon the manner of the carrying-out of the idea, whether by a special bureau, or by enlarging the powers and duties of existing departments.

Among the discussions that occupied the attention of the conference, perhaps the most interesting one was that opened by Prof. Henry A. Rowland, upon the theory of the dynamo-electric machine. Professor Rowland maintained, that, neglecting the question of strength and rigidity and other such mechanical reasons, a single magnetic circuit is better than a double one: meaning, by a single magnetic circuit, such a one as would be obtained by placing the armature between the poles of an ordinary horseshoe magnet; and by a double magnetic circuit, one of the form obtained by putting two horseshoe magnets end to end with their similar poles together, and putting the armature between the compound north and south poles thus formed. In the single circuit the lines of force, after passing through the armature, can only return in one way through the magnet; in the double circuit, however, the lines of force can return by passing around either through one magnet or the other. Professor Rowland is of the opinion that there is far more leakage of the lines of force in the case of the double circuit than in the case of the single; and therefore, other things being equal, the single circuit is the better form. This is, however, a question that should be investigated by experiment. Both forms of dynamo should be carefully examined to determine the amount of leakage at every point. Such an investigation would be very important. Professor Rowland also advocated the use of magnets of cylindrical section, rather than flat or oval magnets, on the ground that the least amount of wire would then be used to produce the required magnetization of a given mass of iron. Professor Silvanus P. Thomson differed on this point, and preferred iron cores of oval section; giving as his reason, that he had found

by actual experiment that the central part of an iron core was not nearly so powerfully magnetized as the outer part. Professor Rowland called attention to the fact that Professor Thompson's experiments had been made with short straight iron magnets, where the resistance of the air to the magnetic lines of force came in as the most important factor, and therefore had led Professor Thompson into error; but that since in the dynamo the only air-spaces are those between the armature and the pole pieces, it closely resembles a ring magnet, where the magnetic circuit is completed in the iron itself, and therefore, as in the ring magnet, the iron in the centre of the core of the magnets of the dynamo is quite as important as that on the outside.

Professor Fitzgerald of Dublin showed that the loss due to self-induction in the armature is proportional to the linear velocity and length of the coils.

Professor Silvanus P. Thompson of Bristol called attention to the fact, that, whenever a coil is short-circuited, there is a real loss of energy in heat; and therefore it is bad to set two brushes, one a little ahead of the other, to reduce sparking, for this prolongs the time during which the single coils are short-circuited. He also noticed that since self-induction is increased in proportion to the increase in the velocity of the armature, or to the increase in the number of turns of wire which it contains, higher electro-motive force is to be best obtained by strengthening the magnetic field. The speaker then referred to the great importance of using the best soft iron in the field-magnets, instead of cast iron; stating that an English maker had nearly doubled the capacity of a machine by substituting for its old cast-iron magnets and pole-pieces new ones made of best forged iron. Professor Thompson even went so far as to say, that, in his opinion, it was important that the *grain* of the iron should run in the same direction as the lines of magnetic force. The speaker also objected to the use of large masses of iron in the magnets, on the ground that the great time required for such masses to come to their full degree of magnetization interfered with their government. Professor Elihu Thomson, on the other hand, stated that when the iron masses were small, the extra current from the machine had so high an electro-motive force as to make trouble, and, when the machine was used for arc-lights, even caused a sort of vibration in their intensity.

Prof. F. E. Nipher of Washington University, St. Louis, opened the discussion of the electrical transmission of energy by a discussion of the case of two dynamos, one being used as a generator, and one as a motor. He showed that the performance of such a system could be advantageously studied by a series of three surfaces; in each surface two of the variables being the speeds of the two machines, and the third variable being in the three surfaces respectively, the work supplied to the generator, the work done by the motor, and the efficiency of the system as indicated by the ratio of these two quantities of work.

The question of storage-batteries was discussed at considerable length. Mr. W. H. Preece of London opened by a paper upon the subject, giving his expe-

rience in the use of cells of the Planté form. He has these cells in his house; using electricity not only for lighting, but in many other ways. The cells are charged for two hours every day by a dynamo machine; but he hopes, when the cells are in a little better condition than now, to have to charge them only once a week. Each cell is made up of twelve sheets of lead about a foot square, and separated by thin sheets of hard rubber punched full of holes; the alternate plates are joined together, thus forming two sets of six plates each. Professor Dewar of Cambridge, England, gave an account of the chemistry of the storage-cell, which was of very great interest. There was considerable general discussion upon the subject of the storage-battery, and there still seems to be much to be cleared up in regard to its action. The chemical actions are by no means simple.

The subject of long-distance telephony and the difficulties that attend it was introduced by Mr. T. D. Lockwood, who in a long and interesting paper gave the results of a great deal of experience with long telephone lines. Some interesting points were brought out. The noises on telephone-lines arise not only from electro-static and electro-dynamic induction, but also from earth-currents and atmospheric electricity, imperfect contacts, and leakage from other lines. Long lines are, of course, more subject to these troubles than short ones; and lines running north and south are more subject to disturbance than those running east and west. Sometimes one end of a line will be noisy and the other quiet, as between Chicago and Milwaukee, where the Chicago end is very quiet, but the Milwaukee terminal is very noisy. Lines subject to pretty uniform leakage are less noisy than well-insulated ones; perhaps, for this reason, lines near the sea are quieter than those inland. Lines on high or mountainous land are subject to periodic storms, the noises being most intense at certain hours of the day. Lines constructed of wire of high conductivity are less noisy than those of greater resistance. Lines of small wire, thus having less electro-static capacity, are less noisy than lines of large wire. A good method of treating a noisy line is to provide a metallic return-circuit, hung parallel to the first, and similarly to it. Many of the sources of disturbance will thus be gotten rid of. In case of a long air-line, ending in a short underground cable, the person at the end of the cable can make himself heard at the other end of the line, but the man at the end of the long line can not make himself heard. For short lines, less than two miles in length, cables of insulated wire covered with tinfoil, this covering being grounded, are useful, and get rid of some sources of disturbance; but, on account of the large capacity of such a line, the retardation is very great.

Professor Fitzgerald, who was expecting to give an abstract of the paper read by Lord Rayleigh before the British association, on the subject of long-distance telephony, had been obliged to leave, so no complete presentation of Lord Rayleigh's results could be obtained: but Professor Rowland made a brief statement of the nature of the problem, that

the passage of the wave-current propagating the telephonic action was exactly similar to the sinking of the heat-waves into the earth, treated by Fourier; and by reasoning from the nature of that wave propagation he concluded that the sound of a deep bass voice could be heard farther than that of a high-pitched voice. Mr. Lockwood said that experience in ocean-cable telegraphy confirmed this. Professor Carhart stated that Lord Rayleigh had from similar considerations calculated the farthest distance at which telephonic communication could be maintained in such a cable as the Atlantic cable, and gives the extreme limit as twenty miles. This is fully confirmed by experience, according to the testimony of Messrs. Preece and Lockwood.

Capt. O. E. Michaelis, of the Frankford arsenal, read a paper in which he recommended the study of the 'structural metals,' iron, copper, brass, etc., by electrical or magnetic methods, with a view to ascertaining whether some such methods could not be devised that should detect weaknesses not otherwise to be discovered.

A short discussion then took place, on the measurement of large currents, in which there was nothing particularly interesting brought out.

Professor Rowland then took up the subject of lightning protection, and gave a short development of Maxwell's suggestion that the house should be placed in a metallic cage. A house in a complete metallic cage, one enclosing it *below* as well as above, would be completely protected if the wires of the cage were sufficiently good conductors. This fact leads to the following considerations. Lightning-rods should run down the four corners of the house and across the angles of the roof, joining at the top, thus forming the skeleton of a cage. If rods are also run down the middle of the sides of the house, or if, in a long building, two or three equidistant rods are run down the sides and connected with the

rods running across the roof, so much the better. These rods must be *well* grounded, otherwise they are of no use at all, and may be worse than useless; for, suppose the gas-pipes running through the house have good earth connections, the lightning will be likely to leap from the rods to the gas-pipes, and so cause destruction. The rods down the sides should therefore be connected by rods running across *under* the building, as well as by those over the roof; and the gas and water pipes, as well as all large masses of metal in the building, should be connected with the rods by good conductors. It is, of course, necessary that the rods should be of good conducting material, — solid, not hollow. As it is important that the rods should have a large cross-section, the twisted forms with large surface and very little mass of metal are not good, as there is no use in the twisting, and the most important thing is that there should be plenty of metal to conduct. There is not the slightest necessity for insulating a lightning-rod: the safety of a building depends only on its being easier for the lightning to go around it than to go through it. Of course, from the cage of rods above described, small rods bearing points are to rise at different points on the roof. How high these should be, or how close together, is not very well determined. It is considered by some, that a rod protects the space included in the cone whose height is that of the rod, and the radius of whose base is also equal to the length of the rod. Others think that a space is protected equal to the cone whose height is that of the rod, and whose base has a radius of twice that amount.

The time for adjournment having come, the conference adjourned, subject to the call of the chairman, Professor Rowland, who is also president of the commission.

It is possible that there may be another session in Philadelphia about the close of November.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROCEEDINGS OF THE SECTION OF ANTHROPOLOGY.

THE admirable survey of the progress of anthropological science, comprised in the address made by Dr. Tylor as president of the section, was listened to with great satisfaction by the members. In this association, as in the American, anthropology has been late in finding the recognition which its importance as a science deserves. Heretofore it has been treated as a department of the biological section. As the communications have gradually taken a wider range, and become more numerous, it was found that this subordinate status was inconvenient. At the present meeting, anthropology for the first time takes the rank of a section, and with a fortunate choice of officers, — the vice-presidents being Professors Boyd Dawkins and Dr. Daniel Wilson, and the secretaries

Messrs. G. W. Bloxam (recorder), Rev. J. Campbell, Walter Hurst, and J. M. P. Lemoine.

Among the papers which attracted most attention may be ranked that of Professor Boyd Dawkins, on the range of the Eskimo in space and time. In this paper Professor Dawkins again urged with much ingenuity and force his well-known opinions as to the probability that the Eskimos are the survivors of the prehistoric race known in Europe as the 'cave-dwellers.' The Eskimos are found along the Arctic Ocean, from Labrador and Greenland to the west coast, and thence extending into Asia. Everywhere they appear to be a receding race, gradually retreating northward as they are pressed by stronger and more warlike tribes, — in America by the Indians, in Asia by the Mongols. The researches of Mr. Dall had produced evidence that they formerly dwelt on the west coast of America, far south of their present

limit. In Asia some linguistic evidence, in Professor Dawkins's opinion, showed an intercourse or intermingling between them and the Mongols, at points far to the south-west of their present abode. He did not consider that the mere fact that they spoke an agglutinative language could be regarded as evidence that they were akin to the Indians. In appearance, character, and customs, they were a distinct race; and there was a strong antipathy between them and the Indians, resulting in frequent hostilities. In fact, a wide belt of debatable land was always left between the two races. In Asia their relations with their southern neighbors were more pacific.

In dealing with the range of the Eskimos in time, we pass from the historic ground into the domain of geology. We have to go back to the 'cave-men,' as they are styled, whose traces are found not only in caves, but along the course of rivers and in other localities. They dressed in skins, and wore long gloves. They were skilled in the use of the needle, which was made of bone. They wore necklaces; they painted their faces. They manufactured skin-scrapers, harpoons, lance-heads, and other implements, of stone and bone. They were manifestly a race of hunters and fishermen, of a rather superior type. They were also artists of no mean skill, as a sketch of a reindeer and the outline of the head of an elephant (of both of which copies were exhibited) fully testified. Of human remains belonging to this race, there was unfortunately an almost entire lack. Professor Dawkins did not believe that any of the skeletons or crania usually referred to this people really belonged to them. There was every reason to think that they did not bury their dead, but left them to be devoured by the wild beasts, and especially the hyenas which then abounded in southern Europe.

This and all the other characteristics of the cave-dwellers are precisely those of the Eskimos of the present day. They are hunters and fishermen, wearing skin dresses with long gloves, are highly artistic in their tastes, and do not bury their dead. If the question is asked, how they came to emigrate to America, it must be remembered that the same question applied to the mammoth which they hunted. Remains of this animal are found in great abundance from western Europe across northern Asia, and thence throughout North America. They had, of course, passed over at a time when the two continents were united at what is now Bering Strait. When the mammoth, and the animals which were contemporary with it, migrated in this direction, the cave-men who hunted them would naturally go with them. In all probability there was a period when people of this race were scattered over a wide region of the earth extending from western Europe to northern America.

In the discussion which followed, Prof. T. Rupert Jones expressed the opinion that the skeletons found in the caves and other localities where the implements of the cave-dwellers have been discovered belonged to this race; and if so, they were a tall people, of a bodily structure very different from that of the Eskimo. Dr. Wilson remarked that the hostility be-

tween the Eskimos and the Indians adjoining them is no greater than that which often exists elsewhere between two tribes of Indians; as, for example, between the Sioux and the Chippewas, where it is always found necessary to keep a wide space of uninhabited land between them. As to the similarity of implements and usages, that is common between barbarous races whose condition and surroundings are similar. The fact that the Eskimos do not bury their dead is readily accounted for by the climate, which would usually make burial impossible. Professor Dawkins, in reply, insisted that there was no evidence that the skeletons mentioned by Professor Jones belonged to the cave-men. He believed them to be intrusive burials. As to the similarity of implements, it must be remembered that in the present case the resemblance extended far beyond a few rude stone or bone tools and weapons, and included the element of artistic faculty and products. The result of the discussion appeared to be, that the paper, while admitted to be highly valuable as a contribution to our knowledge of the subject, left the opinions on the different sides as widely apart as before.

Mr. F. W. Putnam gave a most interesting account of his examination of a group of mounds in Hamilton county, O., made on behalf of the Peabody museum at Cambridge. Discoveries were made which seem to far exceed in interest and importance any thing which has before been learned concerning the builders of these mounds. As this search will be the subject of a much more elaborate paper, which will be read before the American association, a summary of it would be out of place here. All that need be said is that the facts detailed by Mr. Putnam seem to show a more complex social life, more abundant and varied artistic products, and a higher status altogether, than can be deemed consistent with the views of those who hold that these mound-builders were merely the ancestors of our present Indians, and in the same stage of culture.

An important communication by Major Powell, on the classification of American languages, was illustrated by an ethnographic map, comprising the greater part of America north of Mexico, with some vacancies where the affinities of the tribes are considered by him to be not fully determined. The number of distinct linguistic stocks in this region is quite large; and as they have been studied by many investigators, some confusion has arisen from the variety of names given to them. Major Powell proposed to adopt a system of nomenclature based on certain definite rules. One of these rules is to adopt the name given to each stock by the author who had first written about it. He would not, however, go back for this purpose beyond the year 1836, the date of the publication of Gallatin's 'Synopsis of the Indian tribes,' which might be deemed the first scientific work on American ethnology. Another rule would be to discard all double names, that is, all designations formed by the union of two names, such as Huron-Iroquois, or Algonkin-Lenape. Finally, to distinguish the name of a linguistic stock or family from that of a language or dialect included in it, the former or 'stock' designa-

tion should always terminate in '*an*.' Thus we should have Eskimoan, Shoshonean, Algonkian, Iroquoian, Pawnee, and the like, as the names of the different stocks. He was decidedly of the opinion that no mode of classifying the Indian tribes other than by their languages would be found satisfactory. The physical differences are certainly not sufficient. The arts are no criterion, as they are readily adopted by one race from another. Institutions are more permanent; but still in some cases they are adopted, and they do not sufficiently distinguish the races. Mythologies are more distinctive; and, indeed, it will generally be found that tribes speaking languages of one stock have similar mythological beliefs. There are in North America about eighty linguistic stocks, and as many mythologies. The investigation and classification of these stocks and of the languages included in them is an important part of the work which is now engaging the attention of the U. S. ethnological bureau.

In the discussion which followed Major Powell's communication, it was suggested that the establishment of a complete ethnological nomenclature was properly the work of an international commission, such as had been found necessary in geology and in electrical science. It would be a very suitable work for a committee of the anthropological section in the International association for the advancement of science which seems likely to be formed. Professor Max Müller, it was mentioned, had proposed for sub-families or groups the termination in *ic*, as Indic, Persic, Tataric, Ugric. These and other suggestions could be considered by an international committee, whose conclusions would probably be generally adopted, and thus the confusion and uncertainty of names which now cause much perplexity would be removed. This suggestion was received by the section with indications of general approval.

Mr. C. A. Hirschfelder's paper on anthropological discoveries in Canada gave much very interesting information. His investigations have been quite extensive, including the opening of over three hundred Indian graves and mounds. The large number of Indian wares and relics found in these excavations now form an important part of the collections of the Canadian ethnological museum at Ottawa. A description of the vast Huron ossuaries, or bone-pits, was given, fully corroborating the accounts of the Jesuit missionaries. The earthworks of Canada are much more numerous and important than has been generally supposed. Most of these are considered by Mr. Hirschfelder to be the work of the Hurons and other tribes known to us; but one, of evidently very ancient date and peculiar character, he is inclined to ascribe to the mound-builders of the Ohio valley, or a race akin to them, as it bears a strong resemblance to the works constructed by that people. It is situated on an elevated ridge in the county of Elgin, a short distance north of Lake Erie, and has much the appearance of having been a stronghold in a hostile country. It comprises about eight acres, the dimensions being four hundred and twenty-eight by three hundred and twenty-five feet. A double wall, separated by a ditch

twenty feet wide and five feet deep, forms the defence. The outer wall is thirty feet thick, and has on the inside a ledge where a row of men could lie at full length concealed from observation. All the arrangements show that the fortress was intended to have a strong garrison, and to be prepared to meet a large assailing force. The numerous burials and weapons in the vicinity seem evidences of a protracted warfare carried on around it. The antiquity of this singular fort is shown by the size of the trees. The largest of these is over eleven feet in circumference, and must have been nearly four hundred years old. Various indications seem to show that the defenders were finally conquered by overwhelming numbers. A natural conjecture would be, that the mound-builders had planted this outlying fortress in a conquered territory north of Lake Huron, whence they were finally expelled by the native tribes. Mr. Hirschfelder's paper contained much other information of great interest.

A very valuable paper on the Huron-Iroquois as a typical race of American aborigines was read by Dr. Daniel Wilson, evincing the wide research and careful induction characteristic of the writer. The number and extent of the Huron-Iroquois nations were described, with the characteristics which distinguished them from other Indian tribes. The people whom Cartier found at Quebec and Montreal were evidently of this race, and the evidence tended to show that they were of the Huron division of the race. The crania of the Huron-Iroquois people, like those of the northern Indians generally, were long and well developed. The contrast between their skulls and the nearly globular crania of the Ohio mound-builders was striking. The latter people were evidently very numerous and well-organized, though they had not attained an advanced degree of civilization. After examining all the evidence on the subject, the conclusion to which he had been brought was, that the mound-builders were a people of a not very high type, who were under the control of rulers of superior energy, a sort of Brahminical class, by whose direction their remarkable engineering works were constructed.

In a subsequent paper Dr. Wilson described a skull from the loess of Podbaba, near Prague; and one found in alluvium at Kankakee, Ill., along with the tooth of a mastodon. He compared the former with the famous Neanderthal skull, termed pithicoid by Huxley, and showed that there was in certain points a striking resemblance, and yet there was no evidence in the former of deficiency of brain, and probably would not be in the latter if we had the whole of it. The Kankakee skull, though found under circumstances which seem to indicate for it as great antiquity as that of the Neanderthal and Podbaba crania, is a well-formed Indian skull of the usual type. There is, however, no clear evidence that its contiguity to the mastodon's tooth was not the result of accident. It can only be said that they were found near together, and that the discoloration is about the same in both. Dr. Wilson is, however, inclined to believe that the mastodon existed to a later time on this than on the

eastern continent, and not improbably man will be found to be contemporaneous with it.

Major Powell gave an account of the peculiar marriage laws of the American aborigines, prefaced by some general considerations on the motives which had led to the establishment of these laws. These he traced mainly to the desire of preserving peace, which was a marked characteristic of the domestic legislation of the Indians. This was illustrated in their burial customs, in disposing of the effects of the deceased, and in other usages. As one of the main causes of dispute among barbarous tribes is for the possession of women, it was natural that their laws should be specially strict on this point. The manner in which marriages are regulated for this object, and especially the influence of the clan system, were clearly pointed out. As the paper is understood to be a summary of the contents of a large work, which will shortly be published in full, further details need not be added here. The clear and judicious views propounded were highly commended by Dr. Tylor.

An entertaining paper, on the customs and languages of the Iroquois, was read by Mrs. E. A. Smith. The peculiarly descriptive force of the names given by the Iroquois to the animals and other common objects surrounding them was shown by many curious examples. The word for rattlesnake means 'he squirms;' for rabbit, 'two little ears together;' for goose, 'it breaks its voice.' Tears are 'eye-juice;' sugar is 'tree-juice.' This is a mode of word-formation common in other Indian languages. Mrs. Smith affirmed that the missionaries and all other authorities who have heretofore written on the Iroquois languages were mistaken in their views as to the genders and pronouns of these languages, — a hazardous assertion. The conclusions of educated French and English missionaries, who have spent many years among the Indians, and speak their language fluently, can be properly controverted only by one who has given the same amount of time and attention to the study.

An elaborate and extremely interesting paper by Mr. F. H. Cushing, on the development of industrial and ornamental art among the Zúñis of New Mexico, illustrated by many pictorial designs, attracted much attention. It is impossible in the limited space at command to give even a summary of the contents of this valuable communication. An outline of the reasoning is all that can be attempted. Mr. Cushing finds reason to believe that the civilization of the Zúñis is purely indigenous. When they first entered on their existence in the little oases of the desert which they made their home, they were in a very low stage of barbarism; out of which they gradually raised themselves by a slow but steady course of self-development. The stages of this progress were set forth with much ingenuity and clearness. Their residences rose gradually, from the brush-covered wigwam to the small building of lava-stone, either isolated near a spring, or fastened for security to the shelf of a cliff; and thence to the huge, many-storied stone barrack, which is both cliff and dwelling in one. In like manner their earliest vessels of gourds, when in-

cased in wicker-work for the convenience of transportation, gave the first idea of a basket or wicker tray. The basket was lined with clay to retain the food which was boiled in it; and from this custom, the knowledge of pottery took its rise. The first ornamentation of their pottery was derived from the imitation of wicker-work. Afterwards other elements of a pictorial nature came in. The gradual progress of these improvements was traced by Mr. Cushing with a care and minuteness which leave no doubt of the correctness of his theory. We thus learn the interesting truth, that civilization and art, of no mean type, may spring up among a rude people, without external impulse, in a few centuries; for Zúñi culture and art are evidently not many centuries old. The notions which some anthropologists have entertained, that many thousands of years are needed before a savage people can emerge into civilization, — which the Zúñis are just touching, — are dispelled by Mr. Cushing's discoveries. In tracing the course of this progress, good use is made of linguistics, by resorting to the original meaning of the names given by the natives to the various objects under consideration. The name of the object is found, in many cases, to give the clew to its origin.

A remarkable paper on the races of the Jews was received from Dr. A. Neubauer, now residing in England, who was described by the president as one of the most distinguished rabbinical scholars of Europe. Dr. Neubauer's essay aimed to controvert the common idea that the Jews differ from most other nations or races in the special characteristic of their purity from foreign intermixture. So far is this from being the case, that, as was shown by much evidence drawn from the Scriptures and other historical sources, the Jews have always been inclined to foreign marriages. Moreover, the number of proselytes to Judaism from the surrounding races has been very great. Few races, in fact, have undergone more intermixture with other stocks. The physical and moral differences between the communities of Jews in various parts of the world are very great indeed; and these are accounted for partly by their intermarriage with other races, and partly by the influences of their environment. To come to a thoroughly scientific conclusion as to the Jewish physique, about which many erroneous ideas are entertained, careful admeasurements are necessary. Dr. Neubauer suggested that when such admeasurements are made, the right point to begin at would be Jerusalem. The paper made a strong impression, and the president expressed his full concurrence in Dr. Neubauer's views.

An account of the habits and customs of the Innuit or Eskimos of the western shore of North America and of Point Barrow, the extreme north-west portion of the continent, was read by Lieut. P. H. Ray, and contained many facts and conclusions of much interest. He gave his reasons for believing that the Eskimos had occupied the far north of America from a remote period. Among other facts, he mentioned that snow-goggles, such as are used at present, had been dug up twenty-eight feet below the surface of

the ground. The Eskimos are, in his opinion, a people of the ice, and from time immemorial had lived along the ice-border, advancing and retreating with it, but never residing far from it. All their habits of life were formed from this contiguity. He considered them to be a race distinct from the Indians, not merely in language, but also in physical traits and in character. They had brown hair and eyes: a black-eyed Eskimo was hardly ever seen. Their complexion was a clear brown, through which the play of color could be plainly observed. They were naturally a peaceful people, and he had never known a quarrel among them. Though very superstitious, they could not be properly said to have any religion. They had no conception of a future existence. They did not bury their dead, because the climate made this usually impossible. They merely conveyed the corpse to a distance from the village, and left it to be devoured by the dogs. That, they said, was the end of the man. Still they had ideas about a superior being who had created man and other animals; and they also believed in an evil spirit, who was to be propitiated, or rather menaced, into compliance with their desires.

A paper on the nature and origin of wampum, by Mr. H. Hale, described this article as shell-money, differing from the East Indian cowries as coined money differs from bullion. It consists of circular disks or cylinders, made from various kinds of sea-shells, polished to smoothness, and strung upon strings. These served as currency among the North-American Indians, and for a time among the colonists. Strings and belts of wampum were also much employed in the ceremonial usages of the Indians, and as mnemonic records. The use of this money was traced across the continent to California; thence to the Micronesian groups in the North Pacific, where it is universal; and thence to China, where in early times, according to the native authorities, the money was made of tortoise-shell disks or slips

strung on strings. The modern Chinese copper money, known to Europeans as 'cash,' is made in imitation of this tortoise-shell currency, and is strung in like manner. It is also much used in ceremonial observances, like the American wampum. The mode in which the use of this form of money may have spread from Eastern Asia to America is shown by the fact that several Japanese junks have been wrecked on the west coast of this continent during the present century, and their crews have been rescued by the Indians. The Micronesians have also large sailing-vessels, in which they frequently make long voyages, and are often driven by storms to great distances out of their course. From one or other of these sources the Californian Indians may have easily learned such a simple art as that of making and using shell beads for money; and this art was one likely to spread to the other tribes among whom it was found.

In the long and interesting discussion which ensued, the views proposed in the paper were generally approved. Professor Boyd Dawkins suggested for consideration the question whether all money might not have originated in the exchange of ornament. A doubt having been expressed, whether the shell-money was among the Indians a real currency, that is, 'a measure of value,' several facts and authorities were cited on that point. Mr. Cushing stated that it was a currency among the Zuñis, and had a definite value. Dr. Tylor mentioned the decisive fact, that among the Melanesians, who nearly adjoin the people of Micronesia, the shell-money is in use, and is employed in true banker fashion. A native who lends nine strings of this money expects to receive back ten strings from the borrower at the end of a month. To gain this interest, it must be used in common as a medium of exchange, which it could not be if it were not a measure of value.

Some other valuable papers were read; and this, the first session of section H, must be deemed to have been a particularly satisfactory one.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROCEEDINGS OF THE SECTION OF CHEMISTRY.

DR. SPRINGER of Cincinnati exhibited and described some improvements in torsion scales and balances. These instruments are constructed with steel bands or wires, upon the twisting or torsion of which they depend for their action. Professor Caldwell inquired whether balances for chemists were made upon this principle, and their cost compared with ordinary knife-edge balances. Dr. Springer said that the very first one made was sent to Prof. F. W. Clarke at Cincinnati, and used by him for chemical analysis. Professor Clarke said that its use by him was very satisfactory. The adjustments were not easily disturbed, which was a very important matter; and it was as sensitive as a good knife-edge balance.

A paper on the chemistry of roller-milling was read by Mr. Clifford Richardson. The author stated that with ordinary milling the north-western hard winter wheat gave a dark-colored flour. This difficulty is entirely overcome by using steel or porcelain rolls run at different speeds. The results of a large number of analyses of the products of roller-milling were presented in a series of tables. The ash, oil, fibre, and albuminoids increase towards the outside of the grain. In true bran there is no gluten, the gluten cells being scattered through the interior of the grain. All the experiments were made on hard Minnesota spring wheat. Eastern wheat does not work well with roller-milling, the flour being dark-colored.

Dr. A. A. Julien read the report of progress by the committee on indexes of the literature of chemical

elements, appointed in 1882. There have been completed up to the present time, Ozone, by Professor Leeds; Peroxide of hydrogen, by the same author; The speed of chemical action, by Professor Warder; Glucose, by Dr. E. J. Hallock; The action of heat on metallic salts, by Professor Prescott; and about six others are in progress. The co-operation of the Smithsonian institution had been solicited by the committees, in order to reach foreign chemists. The section unanimously indorsed the action of the committee in the steps already taken.

Prof. C. E. Munroe read a paper on examination of the methods proposed for rendering the lighter petroleum oils inexplorable. The author used alum and ammoniac chloride, and found they were both insoluble in the oil, and inactive. Camphor also was used; and this reduced the flash-test, but made a more explosive mixture with air than the vapor of the original oil.

Professor Atwater read a paper on the chemistry of fish. Flounder is the least nutritive of fishes; while the salmon, when fat, is the most nutritive. Oysters have least nutritive matter among the invertebrates; and northern oysters are more nutritive than those from the south. The flesh of fish contains less fat and more water than that of vertebrates. Digestive ferments act upon the flesh of fish in the same way as upon that of the vertebrates, about ninety-eight per cent of the albuminoids being digested in both cases. As ordinarily found, fish gives from five to twenty per cent of edible matter. A member of the British association asked if the integument of the fishes had been examined. Professor Atwater replied that he had confined his attention to the muscular tissues.

Prof. F. P. Dunnington exhibited and described a new form of gas regulator, depending upon the expansion and contraction of a confined portion of air acting upon a column of mercury.

Professor Stewart made some remarks upon a new process of manufacturing leather, by which the depilicated hides are treated with sulphurous-acid gas in closed vessels, the process being completed in about twelve hours, producing a soft pliable leather.

A discussion on valence was opened by Prof. F. W. Clarke. He remarked that it was especially useful in organic chemistry in explaining isomerism and in synthesis. It was also useful in mineralogy; and he mentioned as examples of isomerism the three minerals kyanite, andalusite, and fibrolite, giving a structural formula for each. He then took up the questions of variable valence, invariable valence, and maximum valence, as points that might be discussed. He remarked, further, that valence was an attempt to explain the arrangement of the atoms in a molecule; and spoke of the drawback of being obliged to represent them on a plane surface, space of three dimensions being much nearer the true state of affairs. Prof. B. Silliman remarked that the last statement of Professor Clarke was the key to the whole difficulty about valence. A plane surface is insufficient to explain the facts. He testified to the great utility of valence, and spoke of the chaotic con-

dition of organic chemistry before this question of valence was appreciated. It was a working hypothesis, a scaffold about a building, but not the building. Hypothesis is not always the truth. Prof. W. Ramsey, of the British association, said that the difficulties about valence could be traced to Lavoisier, who worked upon stable compounds as oxides and chlorides. He also thought that a study of the heat of formation of many compounds would be a key to the valence of the elements; and said that the difficulties of conceiving of the motions of the atoms were well illustrated in Sir William Thomson's effort to explain them in complicated vortex evolutions. Mr. A. H. Allen, of the British association, called attention to the failure of chemists to recognize the value of the work of John Newlands, in the periodic classification of the elements usually ascribed to Mendeljeff. Professor Greene remarked that it was best to consider the cause of valence. Professor Ira Remsen testified to the utility of valence. He remarked that there were two ways of teaching: one by giving all the principal theories first, and the other giving the facts and then the theories,—which latter he considered the best method. He had come to the conclusion that valence should never be mentioned until all the important properties of a compound are known. In regard to its value to young students, he thought its use was dangerous until they fully understood its meaning. He believed that the value of valence had been magnified, and that it was better to study the reactions of compound, and the methods for their synthesis, and the manner of breaking up. Mr. A. H. Allen, of the British association, said that many formulae that showed the structure of compounds according to the valence of the elements do not give any idea of the true constitution of these compounds as ascertained from a knowledge of their properties. He gave, as examples of his meaning, potassic dichromate and fuming sulphuric acid. Professor Dewar, of the Royal institution, London, maintained that the graphical method and structural formulae were most useful, but they are often presented in a way that shows an incomplete knowledge of the ideas of the person who devised the formula. He remarked that the text-books contained too many pictures of graphical formulae, and that he considered it better to follow the historical method for developing theory. Professor Atwater thought that some idea of valence should be given at the beginning, as it assisted the student's memory. Prof. W. Ramsey, of the British association, said that he was satisfied of the utility of making the student perform experiments that brought out facts to illustrate the theory of valence, and thus understand its meaning from his own work. Professor Caldwell said that he could not get along with students in chemical analysis who had not obtained some idea of the theory of valence. Professor Remsen thought that the theory of valence might do some good as an assistance to the memory; but such assistance was of doubtful value, and too empirical. Prof. J. W. Langley, vice-president, said that valence, or chemism, may be a force emanating from the atom, or it may be a force outside the atom; it is static, or

dynamic, and a knowledge of it was more a physical than a chemical problem. From the educational view he thought it better to use the theory of valence in connection with the history of the theories concerning atoms and molecules. As a farther step the language and figures of magnetism might be used.

The paper on the optical methods of estimating sugar in milk, by Dr. H. W. Wiley, showed the great importance which must be attached to the influence of albumen on the specific rotary power of milk-sugar. The author prefers to use an acid solution of mercuric nitrate in precipitating albumen, for an excess fails to dissolve the precipitate. Professor Jenkins finds, that on adding sulphate of copper and the potassic hydrate the separation of albumen is very complete.

A discussion on the educational methods in laboratory practice and in the illustration of chemical lectures was opened by Professor Remsen, who remarked that in Germany the student does not go into the laboratory until he understands re-actions, while in England and the United States he is placed there at the beginning of the course. Professor Remsen follows an order of instruction in which the student first becomes acquainted with apparatus and methods of manipulation. He next makes gases, and repeats lecture experiments. He then experiments on oxidation and reduction. Next follows the quantitative analysis of air. Then come alklimetry and acidimetry, with success. This practical work and the lectures occur simultaneously, and by that time the lecturer has reached the metallic elements the students are ready to take up test-tube re-actions with profit. During the first year the student should only just begin analysis. After the general properties of the metals are known, let the student devise methods of separation. The course of instruction in our colleges, Professor Remsen regards as too short, and superficial. Lecture-experiments should never be made for show. Aesthetics and chemistry are entirely distinct. Professor Atwater said that chemistry is taught now, as a rule, after the student has acquired the methods of the classics and has never been taught to observe facts. Chemists must show that their science will give what is called 'liberal culture,' or it will not find a place in our educational institutions. Present methods are not doing this, as they fail to make the student think for himself.

Prof. W. O. Atwater read a paper on the assimilation of atmospheric nitrogen by plants. Experiments were made on pease grown in washed sea-sand, supplied with proper nutritive solutions. The pease acquired from thirty-eight to fifty per cent more nitrogen than they contained originally, and than had been supplied as nutriment. The above result, Professor Langley remarked, is important, as it is contrary to generally received ideas.

Dr. Springer next read a paper on fermentation without combined nitrogen, in which he showed that the ferment found on the stems of tobacco-plants, and which decomposes nitrates, on being applied to starch and sugar gives rise to butyric acid, and appears to prove that we can have life without proto-

plasm. After a discussion upon fermentation, a motion was carried that a committee of the section should petition Congress to afford facilities for the study of fermentation. Dr. Springer, Professor Wiley, Mr. Clifford Richardson, Professor Remsen, and Professor Clarke constitute this committee.

Professor Dewar of the Royal institution read a paper on the density of solid carbonic acid. The solid acid was obtained by compressing carbonic acid snow by a hydraulic press. The specific gravity was found to be from 1.58 to 1.60 of the solid acid. Some little discussion resulted, by which it was brought out that the curves obtained from a study of the critical points of gases may explain some facts in regard to dissociation, as there are many cases where the theory of dissociation and experiment do not agree. The pressure necessary to produce the solid carbonic acid is about one and a half tons.

Professor Munroe described some experiments which tended toward the establishing of a law of deliquescence. The temperature and shape of the vessel were not taken into account.

The composition of human milk, by Prof. A. R. Leeds, was found, on using every precaution, to be: albuminoids varying from .5 to 4.25 per cent, lactose from 4.1 to 7.8 per cent, and the fat from 1.7 to 7.6 per cent. The appearance and specific gravity of the milk never indicated its composition. Improvements in apparatus for rapid gas analysis by Dr. Arthur H. Elliott consisted in reducing the length of the tubes by enlarging the upper portion of them into bulbs, and in substituting a solution of bromine in potassic bromide for the liquid element to absorb illuminants. Mr. A. H. Allen, in his communication on oils, said that shark and fish oils are often unsaponifiable, and hence are not fatty ethers. He believes them to contain cholesterine, like cod-liver oil. The fixed oils can be separated into groups, but we know no process for separating a mixture of lard and cotton-seed oil.

These communications closed the sessions of by far the most successful meeting of section C for many years.

PROCEEDINGS OF THE SECTION OF MECHANICAL SCIENCE.

OWING to previous unfavorable conditions, this was practically the first meeting of the new section (D) of mechanical science. Notwithstanding the great heat, the small and inconvenient auditorium, and the fact that the electrical exhibition deprived the section of much local support, the meeting was a greater success than had been expected, and warrants the anticipation that this will shortly become one of the leading sections of the association as it is in the British association. The attendance was large, and included many prominent English visitors, who furnished papers, and took part in the discussions. In order to indicate more definitely the scope of the section, it has been proposed to extend its title to 'mechanical science and engineering;' and it is hoped that our leading engineers and architects will give it their active support by presenting before it papers embody-

ing the progress of their work from scientific stand-points. Besides appointing a committee of invitation to increase the interest and attendance for the next meeting, two special committees were appointed to work up the subjects, 'The best method of teaching mechanical engineering,' and 'The use and value of accurate standards, screws, surfaces, gauges, etc., and of systematic drawings, in the modern machine-shop.'

On Friday, Mr. J. C. Hoadley read by request his excellent *résumé* of steam-engine practice in the United States; reviewing the different classes of engines, and giving figures to show their economy, with other important facts. Mr. Hoadley classifies engines as follows: large compound engines for pumping, etc., rolling-mill engines, saw-mill engines, marine engines, locomotives, hoisting-engines, steam-cranes, steam-pumps, portable engines, etc., and engines for electric lighting. This would seem to be an enumeration, rather than a classification, of different types of engines. The paper contains, in compact form, information as to all the prominent engines, and forms a valuable addition to steam-engine literature. It will be printed in full in the Transactions.

The subject for the day was then introduced by a paper on the training for mechanical engineers, by Prof. G. I. Alden of Worcester, Mass., in which one phase of the subject was presented. Professor Alden urged the importance of practical as well as scientific attainments, and claimed that the shop for manual instruction should not be such an institution as would be developed by or out of the school, but should bring with it not only the methods but the business of an actual productive machine-shop, the work being done for the market. It is to be regretted that other prominent gentlemen expected to furnish papers were prevented from attending.

The discussion commenced with so much interest, that an extra session was devoted to it, when the various phases of the question were brought out. A starting-point was thus formed which should enable the committee to secure a more complete, important, and decisive discussion next year. Messrs. Rigg, Kent, etc., and Professors Woodward, Robinson, Wood, Thompson, Higgins, Carr, etc., and Webb, joined in the discussion; and the latter called attention to the necessity of distinguishing between machine-shop practice and experiments in the mechanical laboratory, and pointed out three existing and natural kinds of schools: 1°. manual training schools, where the manual exercises are for discipline only; 2°. schools for master-machinists, superintendents, etc., as at Châlons-sur-Marne, where the course is seven hours daily, for three years, in the shop, with such instruction in mathematics, draughting, etc., as can be added thereto; 3°. schools for mechanical engineers (as the *École centrale*), where theoretical training predominates, and where there is either no shop-practice, or only such as is specialized and organized so as to give, in the limited time available, the maximum intellectual and manual grasp of machine-shop methods.

On Monday Prof. W. A. Rogers read a paper on a new method of producing screws of standard length

and uniform pitch; and Mr. J. A. Brashear, a paper on the production of optical surfaces: the subject for the day being the value of accurate screws, surfaces, etc., in the machine-shop. Professor Rogers has developed a method by which practically perfect screws can be cheaply made, and Mr. Brashear has succeeded in making perfectly flat surfaces of larger size than usual. Professor Rogers's method of making a screw presupposes a correctly graduated scale over which a microscope attached to the lathe-carriage moves. The error in the movement of the carriage is thus made visible, and can be neutralized by means of a stout micrometer screw, which varies slightly the position of the cutting-tool on the carriage. By this means the screw is cut so nearly true that the remaining inequalities are easily ground out by means of a long nut cut into four pieces, which can be put together in different ways so as to make the errors in the nut oppose those of the screw. Professor Rogers pointed out the way for further improvements, and hoped that some way would be found for the detection of errors extending over long distances, by means of gratings ruled by the screw. The subject of the proper use and preservation of such perfect screws in the machine-shop was also touched upon by Mr. Pickering, who has found means in his own practice of distributing the work as equally as possible over the where leading screw of a lathe in order to keep it from wearing unequally. This whole subject will come up next year for discussion, and the paper was deemed of such importance as to warrant its publication in full in the Transactions. Mr. Brashear's paper is also to appear in full. The discussion of these papers, engaged in by many prominent physicists and engineers, was highly interesting. It opened by a criticism from one of our English friends, who expected to find every thing in the United States done by machinery, and was disappointed to find that these flat surfaces (or slightly curved, when needed so for lenses, etc.) were produced by polishing, much in the old manner; and it was claimed that the correct form should first be produced by machinery, and the polish put on subsequently. The telescope of Mr. Bessemer was alluded to as an instance where such work would be done by machinery. Several gentlemen followed, and spoke of the difference between ordinary work which might thus be produced, and the extremely accurate forms required for astronomical purposes produced by Mr. Bessemer. Professor Harkness described his measurements of the 'transit of Venus' plane mirrors down to hundred-thousandths of an inch, and showed that work was done in the United States to a degree of accuracy not perhaps appreciated in Europe. Mr. Brashear closed the discussion by a complete defence of his methods. He claimed that the degree of accuracy of his work was such, that, after a surface was polished, he could, by a few suitably lengthened strokes of the polisher, make it parabolic, elliptic, or any thing he wished, and that his principal difficulty was that the finest polishing powders cut too fast, so that to shape first and polish afterward was meaningless: then, growing eloquent, he ventured, for reasons which he explained, to predict that Mr.

Bessemer's telescope never would be completed in the intended manner, and this opinion was evidently shared by many gentlemen present.

On Tuesday Sir Frederick Bramwell explained the method employed to warm the Third Middlesex-county lunatic-asylum at Banstead, Eng., where a circulation of warm water is produced by centrifugal pumps, which maintain two parallel mains in a relatively plus and minus condition. The discussion was a comparison of warm water and steam for heating purposes; and the former was shown to have various advantages over steam, where the expense of the plant is not considered.

Mr. J. C. Hoadley's paper on driven wells followed, and was a description of a series of experiments to determine the way in which water moves toward a well from which it is pumped. Driven wells were shown to obey the same law as open wells; which is, that the water simply runs down hill, toward the well, its flow being more or less obstructed by its percolation through the soil, so that its surface forms a slope more or less steep, i.e., an 'obstructed hydraulic slope.' This is only what was to have been expected, but it is interesting to have it proved experimentally. In the discussion, a fresh-water well was instanced, bored on the sea-beach, in which the water rose and fell with the tide; the weight of the latter depressing the underlying and separating strata.

Mr. W. A. Traill not being present, Dr. Fitzgerald of Trinity college, Dublin, described the Giants' Causeway and Portrush electric tramway. A working model of the same is to be placed in the electrical exhibition. Water-power is used for this line, which is six miles long, the American turbine used being a mile beyond the end; so that the maximum distance over which the electricity is carried is seven miles. The rails carry only the return current; there being a third rail, on two-feet-high posts at the side of the track, for the direct current. Two springs rub along on this rail to connect it with the dynamo in the car: these being placed as far apart as possible, an opening less than their distance apart can be passed without breaking the current. The railway, however, runs along a cliff by the sea, so that there are but few openings. The road, though new, is represented as a complete success. The line is quite hilly, the maximum incline being one in twenty-eight; crossing-places are all arranged on an incline, so that the car running down can give up the third rail to the other, and go on by gravity. The electrical arrangements were planned by William Siemens, his death occurring just as he had seen the whole thing in successful operation. It is interesting to note, that the current itself has been used to telegraph to the next car, ordering it to stop. The current is governed by a man in charge of the turbine, who regulates the water to the work: this reminds us of the suggestion of Professor Thompson at the Montreal meeting, that the fireman should be able to completely regulate an electric-light plant by his firing. Running expenses by horse-power, steam-power, and by the turbines, are found to be in the proportion 10:7:3; so that, where

water-power can be obtained, an immense saving can be effected by the arrangements here used. Dr. Preece followed, and described Mr. Holroyd Smith's improvements in electric railways. Mr. Smith employs much the same arrangement as on our cable lines, using, however, in place of the cable, a pair of fixed electrical conductors, between which runs a shuttle; the current is taken off by it, and brought up to the car through the groove, thus placing the electric conductors under ground, as they evidently should be. Other minor details were described, otherwise the line is essentially the same as that previously described.

Mr. A. Stirling then followed with a paper in which the economy of the electric light was made the subject of calculations based on the author's experience. It was stated, that at present, for lighting a compact block, the incandescent light could be considered as no more expensive than gas at \$1.69 per thousand. Mr. Preece opened the discussion by a criticism on the theoretical character of the calculations given, claiming that no dependence could be placed on such statements, and went on to give his own experience, which, however, appeared to fairly sustain Mr. Stirling's figures. He stated that he had experimentally lighted three miles of streets in London (Wimbledon), and that it was not a success; the turning-point seeming to be the price of gas, \$2.25 in New-York city, but only one-third that price in London. Mr. Preece described his own establishment, where, by means of a gas-engine in the garden, the house is lighted in the most convenient fashion (including a doll's house of four rooms). He stated also, that the same quantity of gas gave more light when thus indirectly used, than could be got from it by burning it in the best gas-burners: this is readily to be believed, the gas furnished by gas-companies being much better adapted for producing heat than light. It is to be hoped that the time will soon come when the present gas mains and pipes will be employed to distribute gas for heating-purposes alone. Instances were given where the amount manufactured had been increased, or the quality of the goods improved, over ten per cent, by the introduction of electric lighting. Mr. Preece explained the superiority of this light, by saying that while in the arc light a candle-power was obtained by the expenditure of but one watt of energy, or by the incandescent light two and a half watts, gas required the equivalent of sixty-two, and candles of ninety-seven watts, for every candle-power produced. The great stumbling-block in universal electric lighting was shown to be the enormous cost of the mains for conveying the electricity over long distances. At the afternoon session, Mr. Crompton exhibited a piece recently cut out in repairing the first submarine cable ever constructed, and which he laid under the English Channel over thirty years ago. The model was then sent to the historical collection of the electrical exhibition as a donation to the Franklin institute. Mr. J. Dillon read two papers describing his method of regulating floods and an automatic method of sounding the bottoms of shallow rivers. The first depends on

sluices which are automatically opened and shut by large floats; and the second consists principally of an arm dragging along on the bottom, and taking various angles according to the depth of the river. Prof. J. B. Johnson's paper on Three problems in river physics was devoted to a discussion of the transportation of sediment, and the formation and removal of sandbars; the flow of water in natural channels; and the relation of levees to great floods, and to the low-water navigation of rivers. Sediment was distinguished as either continuously or discontinuously in suspension, or as rolled along the bottom; and the action of the second sort in the formation of bars was discussed. It was also shown, that the third kind produces sand-reefs on the bottom which move along perhaps ten to thirty feet per day: they are sometimes fifteen feet high, and succeed each other at intervals of some three hundred feet. For the flow of water, the old formulæ were shown to be worthless; but the author did not make the mistake of giving new ones. Levees were discussed, and their use discountenanced; waste weirs into side outlets being recommended. This paper will be printed in full. Mr. O. Smith's paper on topography of machines referred to more exact and systematic methods in drawing and speaking of machines and parts thereof, and should have been discussed on Monday. On Thursday, Mr. Arthur Rigg discussed the advantages of trip and eccentric gears, and a somewhat lengthy discussion ensued. It appeared that the American practice of employing simple valve-gearing in small quick-speed engines was approved of, though giving a somewhat inferior card to that of a trip-gear engine. Three other papers — 'The strength of cast iron,' W. J. Millar; 'Experiments on belting,' G. Lanza; 'Steam-engine tests,' C. H. Peabody — were, in the absence of the authors, presented by Professors Wood and Webb; and the session concluded with an interesting talk by vice-president R. H. Thurston, on the development of the philosophy of heat-engines.

PROCEEDINGS OF THE SECTION OF GEOLOGY AND GEOGRAPHY.

It will be readily admitted by all who were in attendance upon any of its proceedings, that the sessions of section E of the Philadelphia meeting of the American association possessed, both as regards the numbers present and the character of the papers presented, a very unusual interest. As a special feature, might perhaps be mentioned the large amount of attention devoted to those most difficult of geological problems relating to pre-fossiliferous strata and the origin of the crystalline schists, — questions which not only in the meetings of the association, but in the world generally, seem year by year to be claiming an ever-increasing share of geologists' thought and study.

This tendency was well marked by the opening address of the vice-president of the section, Prof. N. H. Winchell, on the crystalline rocks of the northwest, a paper which needs no notice here, as we have

already printed an abstract, and which according to the usages of the section admitted of no discussion.

The real business of the section was commenced on Friday morning, the day succeeding its organization, by the reading of a paper, by Prof. S. G. Williams of Cornell university, on the gypsum deposits of Cayuga county, N. Y. He maintained, on paleontological evidence, that these beds were members of the lower Helderberg formation, instead of belonging, as might have been expected, to the Salina period. A section illustrating their occurrence was discussed, and four distinct reasons given for considering their origin to be due to the action of sulphur-springs on beds of impure limestone.

A paper by Prof. E. Orton of Columbus followed, in which he showed how the remarkable symmetry and order pervading the lower coal measures in western Pennsylvania and Ohio extend across the Ohio River into Kentucky. Sections in both Pennsylvania and Ohio were carefully analyzed, and especial stress laid upon the importance of certain thin limestone beds accompanying the coal measures as reliable geological guides. Credit was given to Professor Crandall for having first shown that the sequence of beds was the same on the Kentucky side of the Ohio River as it was in Ohio. An interesting discussion followed this paper, between Professors Lesley and Orton; the former affirming that no traces can now be found of what were the shores of the original coal basin, and that no elevations or depressions accompanied the deposits of coal-seams, while the latter maintained that the evidences of the old shore-line, especially in Ohio, were very manifest.

Prof. F. D. Chester read an account of the geological survey of the state of Delaware, upon which he has for some time been engaged. He exhibited an unpublished map defining the small areas occupied by Laurentian and Cambro-silurian rocks in the northern part of the state; but naturally devoted most of his attention to the more important clays, sands, and marls, which represent the cretaceous, tertiary, and quaternary formations.

The vice-president of the section, Professor Winchell, followed with a description of a salt-well situated at Humboldt, Minn. The brine, although now to be found principally in rocks of Devonian or Silurian age, he considers to have originated in overlying strata, probably carboniferous.

Professor Orton, in a paper on the distribution of petroleum and inflammable gas in Ohio, showed that while scarcely a formation in the whole state was altogether free from them, their presence in really valuable quantities was confined to the subcarboniferous, and even here to two members of this series, — the Waverly conglomerate and Berea grit. These strata alone satisfy the necessary conditions of productive 'oil sands,' i. e., porous layers of sandstone or conglomerate sealed up between impervious layers of shale. As closely connected with the petroleum deposits of Ohio were mentioned the salt-wells, which yield an abundance of brine derived from the same 'oil sands.' This brine is remarkable for the amount of bromine it contains, the production here — one

pound of bromine for every barrel of salt — being greater than anywhere else in the world. The inflammable, high-pressure gas accompanying the salt brine, especially in the Waverley conglomerate or Logan group, is largely employed as well in forcing the brine to the surface as in evaporating it. A lively discussion regarding the origin of petroleum followed this paper; in the course of which both Professor Newberry and Professor Orton held that it owed its existence to the slow distillation of the organic remains originally contained in the enclosing shales, the 'sands' themselves being remarkably free from organic remains, and acting merely as reservoirs.

No paper presented to the section was greeted with more interest or closer attention than that by Prof. J. E. Hilgard, director of the U. S. coast-survey, on the relative level of the Gulf of Mexico and the Atlantic Ocean, with remarks on the Gulf Stream and deep-sea temperatures. Inasmuch as we hope soon to give this most valuable communication to the readers of *Science*, only its two most essential points need be mentioned here. These are: 1° The discovery by a most careful series of levels, run from Sandy Hook and the mouth of the Mississippi River to St. Louis, that the Atlantic Ocean at the former point is 40 inches lower than the Gulf of Mexico at the latter point; and, 2° That ocean-water at all depths exceeding one thousand fathoms possesses a temperature of nearly 35° F., because this is the temperature consistent with its greatest density. Should the water become either cooler or warmer, it must expand; this it cannot do on account of the superincumbent pressure.

Monday was the day which it was proposed, according to the suggestion of the sectional committee, to set apart for papers and discussions relating to the crystalline rocks; but events seemed to demonstrate the apparent impossibility of especially devoting any fixed time to this or any other subject. It is to be regretted that a more definite topical arrangement of papers cannot be introduced into the programme by the committee, and even more deeply is it to be deplored that what little trace of such an arrangement may appear is entirely obliterated by the failure of authors to respond when their papers are announced. Surely a programme carefully arranged according to subjects, and strictly adhered to, would do much to expedite the discussions and increase the interest of the whole section.

The first paper read was one postponed from Friday by Prof. E. W. Clappole, on some fish remains recently discovered in the Silurian rocks of Pennsylvania. Small fluted spines and oval shields were exhibited closely resembling certain fish remains from the Ludlow rocks of England, which for fifty years past have been recognized as the oldest known traces of vertebrate life on the globe. The studies of Huxley and Lankester were quoted as proving the true ichthyic character of these fossils; and the differences between the European and American specimens, based on a microscopic examination, were noted. The horizon in which the Pennsylvanian

specimens were found was considerably below the water-line group (equivalent to the lower Ludlow of England), so that we may safely conclude that these are the oldest vertebrate remains yet discovered.

Prof. A. S. Ewing then presented some calculations regarding the rate of chemical erosion of Appalachian limestones, based on observations in the Nittany valley. These are interesting, but do not, as Mr. Ashburner remarked, seem capable of any general application, since erosion is so very unequal in different areas.

A general discussion upon the subject of maps and map-making was introduced by Prof. George H. Cook's admirable paper on the geological survey of New Jersey. After giving a short account of the work accomplished by the two earlier surveys of the state, the results secured by the existing one, which has been under its present management since its organization in 1864, were recounted. A large geological wall-map of the entire state was produced in 1868, and there were exhibited the three completed sheets of the new and much larger topographical map (scale, a mile to an inch) now in progress. This will finally contain seventeen sheets, and, to judge from what has already appeared, will be a model of accuracy and beauty. The necessity of devoting the small annual appropriation almost exclusively to topographical work has heretofore hindered the study of the geology, but the recent assumption of the former by the U. S. geological survey will now leave this fund free for strictly geological investigations. The practical use of the survey was illustrated in the success of the artesian borings, advised by the state geologist, on the Atlantic coast.

Remarks on the New-Jersey maps were then made by Mr. Trelawney Saunders, Major Powell, and others. A preliminary geological wall-map of the United States, colored as far as reliable data could be obtained, together with another of the states of New York, Pennsylvania, and New Jersey, compiled from the work of Hall, Lesley, and Cook, was exhibited by the U. S. geological survey, and discussed, at the request of Major Powell, especially by those gentlemen present who had aided in their compilation.

Professor Henry S. Williams of Cornell university, in a paper on the influence of geographical and physical conditions in modifying fossil faunas, introduced the exceedingly important subject of the extent to which paleontological evidence is to be regarded as an absolute guide in correlating strata in different regions. This, as is well known, was the subject of the address delivered before the geological section of the British association in Montreal by its president, Professor Blanford, and, as may readily be imagined in view of the many eminent paleontologists present in Philadelphia, excited a lively discussion, the interest in which continued until the final adjournment of the section. Professor Williams explained a series of sections, principally in Chemung and Catskill rocks, taken from a number of localities across New-York state, and deduced from them abundance of proof that faunas in Devonian times, as at present, changed not only geologically in sequence

of time, but also geographically according to the areas of their distribution. The influences which brought about a change in the character of the sediments deposited, also manifested themselves in altering the forms of the organisms inhabiting these sediments.

Mr. Ashburner said that the gradual creeping upward of fossil forms characteristic of one horizon into overlying strata was well borne out in western Pennsylvania. In the oil regions, Chemung forms are often met with in a well-defined Catskill fauna. Professor Claypole considered a gradual transition between two formations as quite the rule, and proposed to call beds of this character between the two horizons especially under discussion, 'Catskill-Chemung.' To such a designation Professor James Hall strongly objected; maintaining that each formation was quite distinct, and that, while there might be an alternation or even commingling of beds belonging to both, no such indiscriminate mixture of typical forms as that described by Professors Williams and Claypole was possible. He would hardly be willing to admit the occurrence side by side at that horizon of *Spirifer disjuncta* and *Spirifer mesostriatus*, to which allusion had been made. Two papers by Professor Hall may be mentioned here, since they bear directly on this discussion, although they were not read until two days later. In the first of these, on the intimate relations of the Chemung and Waverley groups in north-west Pennsylvania and south-west New York, it was shown that the apparent commingling of the Chemung and Catskill faunas is due to the fact that the sea-bottom gradually approached the surface, and thus locally gave rise to dry land. The gray Chemung rocks contain a marine fauna; while the red Catskill beds carry almost altogether land and fresh-water forms, although some Chemung animals survived for a time under the altered conditions. These alternations sometimes extend through three hundred feet. The second of Professor Hall's communications described the recent discovery in considerable numbers of the *Eurypteridae*, a family especially characteristic of Silurian rocks, in carboniferous beds. These widely separated occurrences are connected by a single known specimen of *Eurypterus* from the Chemung formation.

The first of a series of papers relating to the crystalline rocks was read by Professor Roland D. Irving of Madison, Wis. It treated of metamorphism in the Huronian of the north-west; although, according to the author, such metamorphism can scarcely be said to exist at all. The terms metamorphism and Huronian were first defined, and then the rocks considered as belonging to this formation in the vicinity of Lake Superior were classified in five categories. These were: 1° quartzites and graywackes; 2° basic massive rocks; 3° acid massive rocks; 4° cherts and limestones; and 5° hornblende, mica, and chlorite-schists. Each of these categories was then considered in succession, and shown not to be metamorphic in the sense of being sedimentary material re-crystallized *in situ*.

Prof. C. H. Hitchcock next presented thirteen

sections across the states of Vermont and New Hampshire. These were constructed to show the anticlinal structure of the Vermont gneiss, which their author now considers to be established beyond doubt. The gneiss has the same lithological character as that occurring in the White Mountains, where it is of Laurentian age. As is well known, the structure of Vermont has generally been regarded as synclinal; and if the conclusions of Professor Hitchcock prove correct, they certainly have a most important bearing upon the much-discussed problems of New-England geology. If, as he asserts, the Vermont gneisses underlie the Huronian schists, which extend in a V-shaped area from Canada southward along the border between Vermont and New Hampshire, then they must be the oldest rocks of the region, instead of metamorphosed Silurian or Cambrian sediments, as they are at present more generally considered.

No more important contribution has ever been made to the vexed question of metamorphism and the origin of the crystalline schists than the recently published work of Dr. Johannes Lehmann, now professor in the university of Breslau, entitled '*Untersuchungen über die entstehung der altkrystallinen schiefergesteine*,' Bonn, 1884. This elegantly printed book is accompanied by a superb atlas of photographic plates most satisfactorily illustrating rock structures, and was brought to the notice of the association by Dr. George H. Williams of the Johns Hopkins university, who proceeded briefly to review its contents. The most important point brought out by Lehmann is the influence of pressure in the metamorphism of rocks. The great orographic forces which have crumpled the strata have also greatly changed their original form, rendering sediments crystalline and compact, while they developed in homogeneous eruptive masses a schistose or even banded structure. Thus bedding in crystalline rocks is not to be regarded as necessarily a sign of sedimentation, nor is the lithological character of a rock any definite criterion of its age. Professors Carvill Lewis and Hitchcock remarked that these ideas agreed perfectly with what they had observed in the highly crystalline areas which they had particularly studied; and Dr. Williams gave an account of an eruptive mass near Baltimore, in which both changes in mineralogical composition, and the development of a schistose structure, had been accomplished by pressure.

Professor Alexis Julien of New York communicated the results of a very extended study of the Eozoon canadense from nearly all the localities where it has thus far been found, adding other localities of his own discovery. The result of his investigations led him to decide in favor of the inorganic nature of the so-called fossil, although his ideas in regard to the mode of its formation differ considerably from any heretofore advanced. He noticed as universal in all localities, that the calcium and magnesium carbonates were very unequally distributed in the eozoonal limestones; and, that there was a large development of pyroxene where the dolomite was

least abundant. He moreover observed the constant tendency on the part of pyroxene to be arranged in layers alternating with either calcite or apatite, as well as abundant evidence that pyroxene passed by hydration into serpentine, a process which could be seen in every stage at any of the localities visited. From these data it was assumed that siliceous waters, permeating limestones originally evenly dolomitic, would cause the local development of pyroxene by the change of the magnesium carbonate into the corresponding silicate. Were it the case, as so often occurs, that this pyroxene was developed in layers, its subsequent alteration to serpentine or loganite would readily account for all the appearances exhibited by the eozone, without the necessity of appealing to organic agencies.

The Tuesday afternoon session of the section was almost exclusively devoted to geographical papers and discussions. These had hitherto scarcely received their due share of attention; but now proved, owing to the presence of several distinguished members of the British association, of unusual interest. Sir James Douglass was called to the chair, while Capt. Bedford Pim, R.N., presented a paper on the geographical and commercial advantages of the Nicaragua route across Central America. Capt. Pim is especially fitted to speak upon this subject, on account of long experience and the much careful study which he has devoted to the different plans which have been proposed for inter-oceanic communication. He exhibited a section surveyed under his direction, between the years 1863 and 1867, across Nicaragua, and explained how a canal could be constructed at comparatively small expense, for the transference of ships raised upon pontoons drawing only from four to eight feet of water. The principal objection to Mr. de Lesseps's canal across Panama was not, he thought, the practical difficulties of construction, — although these were very great, — but the almost constant, and long-continued calms prevailing on the Bay of Panama. He himself had once been becalmed there for eleven months. This paper elicited numerous questions and remarks from various members of the section, among them a somewhat extended communication by Rear-admiral Ammen, who had served as a member of the commission appointed by the U.S. government to inquire into the relative merits of the various routes proposed for securing a passage for ships across Central America.

Mr. Ashburner, of the second geological survey of Pennsylvania, then proceeded to give a brief account of the work accomplished during the past ten years, the period of the survey's existence, as well as of its future aims and plans. He was succeeded by Mr. Trelawney Saunders of London, who has been so active in prosecuting the recent survey of Palestine under the auspices of the Palestine exploration fund. His first paper contained an account of a remarkable journey over an entirely unknown portion of Tibet, Mongolia, and the frontiers of India and China, by Kreshna, a native surveyor trained under the trigonometrical survey of India. This was only accomplished after four years of unparalleled hardship, but

has made most important additions to the geographical knowledge of Asia. Mr. Saunders's second paper related to the geography of Palestine, in connection with which the great map of the survey was exhibited. Several exceedingly interesting points were explained, where the geographical researches had succeeded in definitely locating sites of biblical events, as well as shed much light upon many heretofore doubtful and difficult allusions in the sacred writings.

The proceedings of Wednesday were introduced by an extended biographical notice of the late Professor Arnold Guyot, by his assistant, Mr. William Libbey, jun., of Princeton. Mr. Libbey's paper will appear in full in the *Journal of the American geographical society of New York*. Mr. William M. Davis of Cambridge gave some valuable hints as to geographic classification, based upon the study of plains, plateaus, and their derivatives. He traced the history of an area undergoing gradual elevation through a regular course of development, likening it to the successive phases in the life of an organism. His remarks, which laid special stress upon the educational value of such studies, were admirably illustrated by a series of paper models showing different stages of development in the history of a plateau.

Professor H. Carvill Lewis of Philadelphia described a narrow trap dyke, which he had succeeded in tracing continuously across south-eastern Pennsylvania for upwards of ninety miles through Bucks, Montgomery, Delaware, and Chester counties. The dyke, which is generally only visible as a line of bowlders, has been apparently faulted in several places; one great fault of several thousand feet up-throw being coincident with a large lateral displacement of both trap and the adjoining strata. Another important fault in the triassic formation was also mentioned, whereby the entire thickness of this formation is exhibited. The trap dyke is distinct lithologically from other dykes, and does not mark a fault, although passing through the Laurentian, Cambrian and Triassic formations.

Professor Persifer Fraser, from a study of a point in the archæan-paleozoic contact-line in south-eastern Pennsylvania near Gulf Mills, concluded that the hydro-mica schists which outcrop there were older than the accompanying limestones, and hence not to be considered as metamorphosed Silurian strata. Professor Carvill Lewis could not agree with these conclusions regarding the structure of this locality; although Professor James Geikie of Scotland, who had recently visited the spot in company with Professor Fraser, expressed himself as entirely convinced of the correctness of the latter's views.

Papers relating to glacial phenomena, which had been so abundant at the Minneapolis meeting, were but scantily represented in Philadelphia. Mr. J. C. Smock spoke of the remains of local glaciers recently examined by him in the Catskill Mountains; and Prof. J. C. Chamberlain, in presenting a paper by Mr. J. E. Todd, exhibited upon a large map the course of the moraines along the upper Missouri River, and explained the effects which these had produced upon the drainage of the region.

Owing to the intense heat which had prevailed throughout the entire meeting, there was but a comparatively small attendance upon the final session of section E on Thursday morning. A large proportion of those down on the programme for papers had already left town; and almost the only communications of real interest which appeared were those of Professors Julien and Bolton, regarding the results of their examination of various sands. Starting some time since with a study of the so-called 'musical sands' occurring on the Manchester beach, they have been gradually led to extend their researches to sonorous sands from many other localities, both American and foreign; and finally to include within them a study of all ocean, lake, and river sands, whether sonorous or not. So far from being rarities, as they were considered some years ago, sonorous beach-sands are found to have an exceedingly wide distribution. Already seventy-four American and thirteen foreign localities are known, and the number is constantly increasing. The loudest sound may be produced by suddenly bringing together two divided portions of the sand enclosed in a bag. When suddenly compressed between the hands, musical notes are emitted, the pitch rising as the quantity is diminished. The conditions of sonorousness, Professor Julien considers to be perfect dryness, uniformity of grain ranging from 0.3 to 0.5 mm. in diameter, and freedom from dust. Any sand satisfying these conditions, no matter what be its nature, he thinks may be musical. Sonorous sands, when wet, generally become quicksands. The microscopic study of a large number of sands of all kinds showed that a great variety of minerals participated in their composition. No such thing as a pure quartz sand was discovered.

In place of the regular session Thursday afternoon, the section was treated to an excursion over the Reading railroad, under the guidance of Professor H. Carvill Lewis. Various points where different formations occur were visited, and the complications of the local geology about Philadelphia were explained as far as understood.

NOTES AND NEWS.

THE semi-annual scientific session of the National academy of sciences will be held in the court-house, Newport, R.I., Oct. 14, 1884, at 11 o'clock, A.M.

— An interesting study of the bed of the Delaware River has just been published by the U. S. coast-survey. It is the report of Henry Mitchell on the methods which have been followed, and the results which have been reached, in recent surveys of what is termed 'the estuary of the Delaware,' from Philadelphia to a point fifty-two miles below. He uses the term 'estuary,' because farther down the stream, there is a submerged delta, with numerous channels, 'not unlike the passes of the Mississippi, or more like those of the Ganges after its issue upon the Bay of Bengal.' The laborious character of this survey may be understood by the statement that seven hundred and thirty-

four cross-sections have been measured, with widths varying from one to five miles, and including many thousand soundings. Professor Mitchell speaks in terms of high praise of the skill with which this work was performed by Mr. J. A. Sullivan of the coast-survey. The point of greatest physical importance is that of the mean depth of the estuary, the bed of which varies so little that the generalized result is best expressed by a horizontal straight line. The fluctuations are chiefly due to inequalities in the nature of the soil. The grand mean of all the soundings is 18.64 feet. The brief report of Mr. Mitchell includes many interesting comments upon the formation of an estuary, to which we can only make this brief allusion.

— Besides those whose names we previously published, the following gentlemen signed the request to the British and American associations, to consider the formation of an international congress. The list is striking as revealing the great extent of the interest felt in the undertaking. The names referred to are: George J. Brush, James D. Dana, James Hall, J. E. Hilgard, J. S. Newberry, Charles A. Young, Charles E. Bessey, William J. Beal, Edward S. Morse, William A. Rogers, Robert H. Thurston, John Trowbridge, J. Burkitt Webb, N. H. Winchell, De Volson Wood, Charles C. Abbott, William Ashburner, W. O. Atwater, M. L. Britton, Robert Brown, jun., W. H. Chandler, Alvan G. Clarke, E. W. Claypole, Joseph Cummings, George Davidson, A. E. Dolbear, Louis Elsborg, S. F. Emmons, J. Fletcher, S. A. Forbes, Simon H. Gage, James T. Gardiner, S. A. Goldschmidt, William H. Greene, Horatio Hale, William B. Hazen, Angelo Heilprin, S. W. Holman, Horace C. Hovey, Alexis A. Julien, Joseph Leconte, J. Loudon, N. T. Lupton, George McCloskie, B. Pickman Mann, H. N. Martin, Alfred M. Mayer, T. C. Mendenhall, William H. Niles, James Edward Oliver, Edward Orton, Richard Owen, A. S. Packard, D. P. Penhallow, W. H. Pickering, William H. Pike, Edmund Baynes Reed, Ira Remsen, John D. Runkle, I. C. Russell, William Saunders, B. Silliman, Eugene A. Smith, Francis H. Smith, Q. C. Smith, M. B. Snyder, Ormond Stone, W. Hudson Stephens, Albert H. Tuttle, Warren Upham, Lester F. Ward, M. E. Wadsworth, Charles D. Walcott, Leonard Waldo, Robert B. Warder, Sereno Watson, Charles Whittlesey, Burt G. Wilder, Alexander Winchell, Henry S. Williams, Jacob L. Wortman, Arthur W. Wright, E. L. Youmans, Joseph Zentmayer.

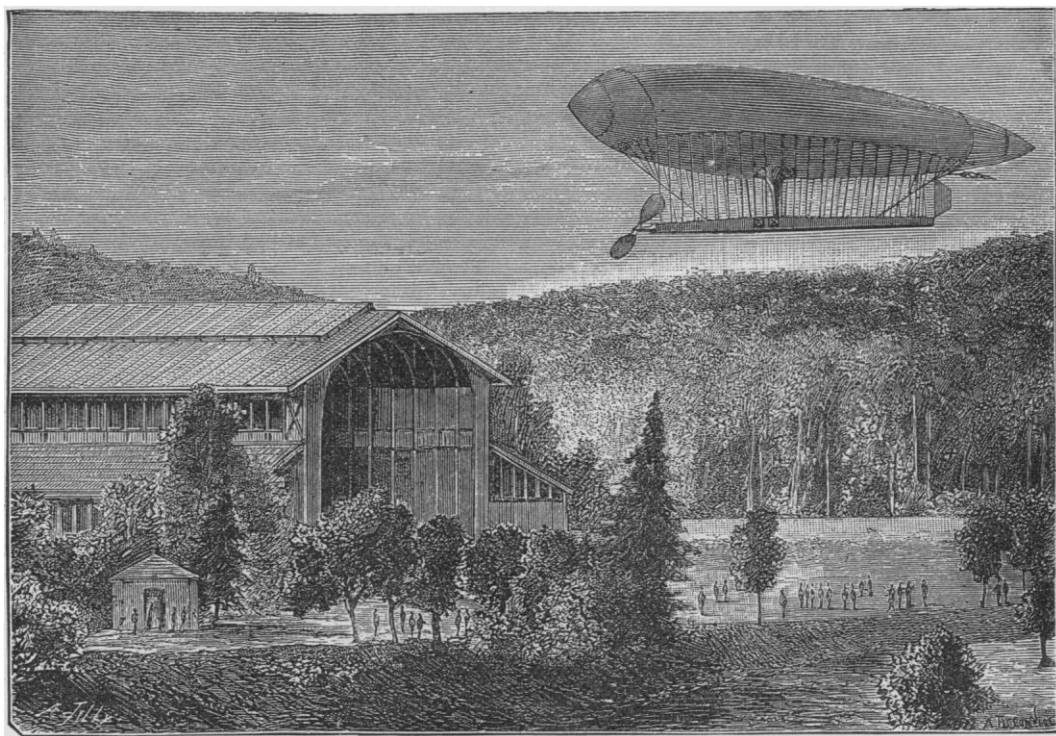
— Dr. Edward Channing received in 1883 the Toppan prize of Harvard university, and the essay which won this distinction has just been printed as one of the Johns Hopkins university studies in history. The theme was the town and county government in the English colonies of North America. The author is led to compare the Massachusetts system of local government with that of Virginia, and to show that both are survivals of the English common-law parish of 1600. The essay concludes with a tabulated statement of local government in England, Massachusetts, and Virginia; by glancing at which, the reader may

quickly comprehend the diversity of usage proceeding from the same stock.

— The new steering apparatus for balloons invented by the two French officers of engineers, Capt. Renard and Capt. Krebs, is attracting considerable attention in warlike Europe. The experiments, for which Gambetta during his short lease of power obtained a grant of 100,000 francs, have been conducted for six years past in the forest of Meudon with the greatest secrecy. The two officers have admittedly been guided in their studies by the earlier labors of Mr. Duprey de Lôme in 1870-72. The conditions laid

four hours. Of their first trip, the inventors made the following report:—

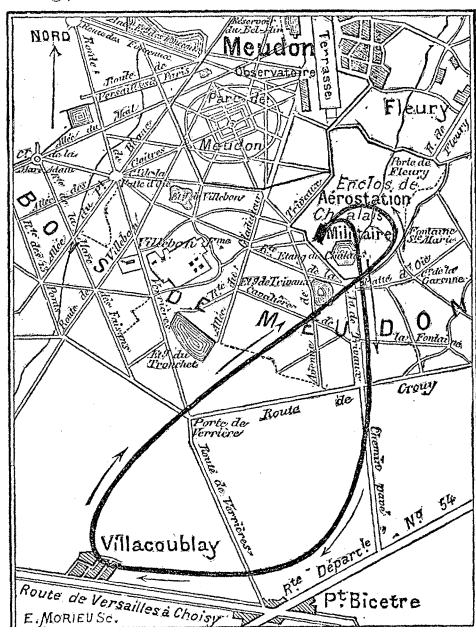
"On Aug. 9, at four P.M., with the wind almost calm, the *aérostat*, with little ascensional power, rose slowly to the height of the surrounding uplands. The machine was put in motion; and soon the *aérostat* increased its speed, obeying the slightest movement of its rudder. The route was first held north and south, toward Châtillon and Verrières, above the road from Choisy to Versailles; and, in order not to become entangled among the trees, the direction was changed to Versailles. Above Villacoublay, we were about four kilometres from Chalais; and, per-



down by the inventors themselves were stability of passage obtained by the cigar-shaped form of the balloon and the arrangement of the rudder, diminution of the resistance of the air by the choice of dimensions, and realization of a speed capable of resisting the winds generally prevalent in France. Capt. Renard undertook the more strictly scientific part of the work, and Capt. Krebs the rest. The former invented the new electric pile of exceptional lightness and power; and the latter constructed the screw and the rudder, and the apparatus for the electric motor. The balloon is formed in the shape of a cigar, pointed at both extremities; a net hangs from it, containing seats for two *aéronauts*, a directing apparatus, and a rudder. It is stated that the force is obtained by a series of electric accumulators of ten horse-power, which may be operative during

fectly satisfied with the behavior of the balloon, we decided to return and to descend at Chalais, notwithstanding the narrow space allowed by the trees. The balloon was successfully turned to the right, the rudder making a small angle (about eleven degrees). The diameter of the circle described was about three hundred metres; the dome of the Invalides, taken as the point of direction, was a little to the right of Chalais. After arriving above this point, the balloon was easily turned to the left; and soon it was hovering three hundred metres above its point of departure. It was necessary to work the machine backward and forward, in order to bring the balloon above the place chosen for the descent. At thirty metres above the ground, a rope dropped from the balloon was seized, and the *aérostat* was brought down in the very meadow whence it had set off.

Several times during the trip, the balloon underwent oscillations of from two to three degrees, resembling pitching; these oscillations were attributed either to



irregularities in the shape, or to currents of local air rising vertically." The balloon is 50.42 metres long, and 8.40 metres in diameter. The course taken, shown in accompanying map, was 7.6 kilometres long, and was finished in twenty-three minutes.

— We learn from the New-York branch Hydrographic office, that the bark Stillwater, Capt. Goudey, from Manilla to New York, passed through vast quantities of floating pumice from May 3 to 25 last, on its course from the Straits of Sunda until off Madagascar. From the 3d to the 8th (when in lat. $11^{\circ} 49' S.$, long. $95^{\circ} E.$), the pumice was very plentiful, with many large pieces; from the 10th to the 20th, in less quantity, with smaller pieces; from the 20th to the 25th, it was seen only occasionally, floating in long streaks with the wind. The pieces, up to six or seven inches in diameter, were covered with barnacles, by the weight of which Capt. Goudey thought it would eventually sink.

— There is hardly any subject in geographical bibliography so interesting to American scholars as the bibliography of Ptolemy's geography; and no one is better qualified than Mr. Justin Winsor to treat of it. His annotated lists of original and augmented text and translations have recently been published as *Bulletin* No. 18 of the library of Harvard university. In addition to the titles, a description is given of every edition which is mentioned, with references to bibliographers' and sales catalogues, and with indications of the American libraries where copies may be found. American collectors have been diligent in their quest for Ptolemies, so much light is thrown by them

on the cartographic development of the new world. The recent dispersion of the library of Henry C. Murphy has tended to the enrichment of many other libraries. Mr. Winsor mentions that President White of Cornell university has lately added several early editions to his collection. Mr. Winsor's critical notes are full of important and recondite lore, and deserve a much more careful *résumé* and discussion than our columns can afford.

— One feature of the year in Europe is the superabundance of insect life. The roses have been fairly eaten away with green-fly (aphis); cockroaches abound, and swarms of dragon-flies are reported in Silesia; on the morning of July 1 the sky is said to have been darkened by them at Ratibor, and on the 2d the same appearance was observed for half an hour at Reichenbach, and along the North Sea coast for five miles inland the same thing has occurred.

— The twenty-fifth general meeting of the German engineers society will be held at Mannheim in September, when the most interesting public works, private manufacturing establishments, etc., will be visited by the members. A special committee will report on the law of industrial protection (patent law, registration of trade-marks, etc.), another will report on steam-boilers and engines, and another on the practical education of young engineers. Among the papers to be read is one by Professor Hermann on the graphical treatment of the mechanical theory of heat, another by Mr. L. Post on the industry of Mannheim and surroundings. This society has now fifty-one hundred members, and has twenty-nine branches in various districts.

— The death of Prof. J. C. Schioedte, a prominent entomologist, and editor of the *Naturhistorisk tidskrift*, at Copenhagen, at the age of sixty-nine, is announced.

— About ten years ago Mr. Krupp of Essen borrowed £1,500,000 to be repaid in yearly instalments extending to 1897; arrangements have just been made, however, for repaying within a short time the whole of the sum still remaining undischarged. These great steel-works, which are now in full operation, employ 19,000 work-people in the various departments.

— The results of Dr. Müller's investigations on the absorption of gases by steel, published in the *Journal* of the Society of German engineers, have been thus summarized in the *Ironmonger*: "The gas liberated from steel in the liquid state before solidification is chiefly carbonic oxide. The rising of steel, and consequently the formation of blow-holes, is attributed to hydrogen and nitrogen, and to a small extent to carbonic oxide."

— A new perfect-combustion stove for domestic use has been invented by Mr. Henry Thompson, of Canonbury, England. Externally it resembles the ordinary register-stove, but in its internal construction it widely differs from it. A recess at the back of the Thompson stove is filled with coal at starting; and behind the coal is a vertical hinged plate, which

is so arranged as always to exert a gentle pressure on the coal and the body of the fire, tending to push the coal forward toward the bars. A slight stirring of the fire causes it to be loosened, and the fuel to be pressed forward to the front to replenish the fire. When the coal has been consumed, the vertical plate is pushed back, and a fresh charge of coal inserted. It will thus be seen that the coal at the back is undergoing a process of coking before being pushed forward. The gases evolved from it, instead of passing up the chimney and into the air in the form of solid carbon, are carried downwards by the draught produced by an ingenious but simple arrangement at the back of the stove, and are delivered beneath the grate. At this point they are drawn upwards through the incandescent fire, in which every particle of smoke is consumed. The waste products of combustion pass up the chimney in the usual way, but without the usual attendant results of smoke and soot.

—A lady, who requests that her name may not be divulged, has offered the University of Heidelberg the sum of 100,000 marks if women are admitted to the lectures; but the senate refused.

—Sibiriakoff's steamers, the Obi and Nordenskiöld, were to leave Arkangel on the 20th of June for the Petshora and Yenisei respectively.

—The Padas, Lawas, and Limbang Rivers of north-west Borneo have been visited by Consul-general Leijss. They lie between the Brunei district and the territory of the North Borneo company. They have been visited by but very few Europeans, and only in recent years. The Limbang appears to be navigable for river-steamers about one hundred and thirty miles, the Padas for one hundred, and the Lawas for only thirty miles. In the interior, on the banks of the two former, is a relatively dense population, occupying a flat country with many sago palms. The country on the banks of the Lawas is attractive, well wooded, hilly, but sparsely populated.

—Sir Erasmus Wilson, the great authority on skin-diseases, was buried in the village churchyard of Swanscombe in Kent, on Aug. 13. He was no less celebrated for his many deeds of philanthropy than for his knowledge of his profession, though his removal of the Egyptian obelisk Cleopatra's Needle to the Thames embankment was the latest thing that brought his name into public notice. It has been stated that the College of surgeons will receive a hundred and eighty thousand pounds as his residuary legacies; the Royal medical benevolent college, the Medical benevolent fund, and the Royal sea-bathing infirmary, Margate, will receive five thousand pounds each.

—The *ærolus* water-spray ventilator, which was fixed eighteen months ago in the physicians' consulting-room of the London hospital, has given such satisfaction to the medical staff, that another installation of the *ærolus* system in the throat consulting-room has been resolved on. The new University of North Wales, at Bangor, has also adopted the system.

—The *English mechanic* states, that many of the provisional orders granted by the board of trade for electric lighting in London will be revoked at once, and unless renewed before the 15th of October, or by that time utilized, nearly all of the remainder will be revoked; so that for the present there is little likelihood of London's being illuminated by the electric light.

—A cable message to Harvard college observatory, from Dr. A. Krueger, at Kiel, announces the discovery of a bright comet, on September 17, by Wolf (probably Dr. Wolf, of the Zurich observatory). An observation was secured at Strasburg, on the 20th, as follows: September 20.4467, Greenwich mean time. R. A. 21h., 15m., 22.3s. Decl. +22° 22' 54". Daily motion in R. A., +20s., in declination +26'.

—The difficulty of soldering aluminium has been one of the principal bars to its usefulness. Mr. Bourbouze has recently communicated to the French Academie des sciences a process which obviates this difficulty. He uses alloys of zinc and tin, or preferably of tin, bismuth, and aluminium, which, he says, take upon the surface of aluminium as ordinary solder does upon other metals. He, therefore, coats the aluminium with these, and any other metal with tin; and then the surfaces may be soldered as usual. For objects which are to be worked after joining, he uses a solder of forty-five parts tin, and ten aluminium, which will stand hammering and turning. For ordinary joints, less aluminium is required. The process is effected with the common soldering-iron, but nothing is said as to the use of any flux.

—A light earthquake shock, lasting ten or fifteen seconds, was felt about 2.14 standard time through Ohio and the adjoining parts of Pennsylvania, Ontario, Michigan, and Indiana. There was no serious damage caused by it; but buildings were shaken, glassware was broken, furniture moved, dishes fell from shelves, and the people in some places ran out of their houses. The strength of the shock would thus seem to be about the same as that of Aug. 10 about New Jersey. Although the Mississippi and Ohio valleys are generally accounted free from earthquakes, the following list from Professor Rockwood's notes in the *American journal of science* includes a number from that region: In 1881 there were shocks in Indiana on April 20 and May 27, and in Ohio on Aug. 29. In 1882, in Illinois on July 20; a general shock through Indiana, Illinois, Missouri, and Kentucky, on Sept. 27; and again, feebler, at midnight of Oct. 14 and 15, over a similar area; and in Illinois on Oct. 22 and Nov. 14. In 1883, about Cairo, Ill., on Jan. 11; through Indiana, Illinois, and lower Michigan, on Feb. 4; and about Cairo on April 12 and July 6.

In the newspaper reports of the earthquake of Aug. 10, it was often incorrectly stated that the shock was felt in Wilmington, N.C. This was a mistake for Wilmington, Del. The few reports of buildings overthrown, and many of the accounts of overturned chimneys, were also incorrect. Special inquiry shows the first reports to have been exaggerated as usual.